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Research Report 1924

Soldier Performance on a New Marksmanship Course of Fire

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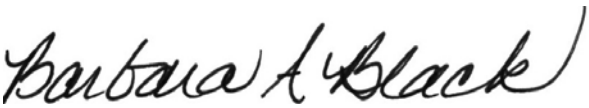

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14. ABSTRACT *(Maximum 200 words)*:

The research investigated a new course of fire, called combat field fire (CFF), to determine CFF marksmanship standards, and where CFF should occur in marksmanship training. CFF is a complex scenario requiring changing magazines, reacting to a simulated malfunction and engaging targets within arrays that require multiple hits. Ten training companies (1976 Soldiers) from the Infantry OSUT and Basic Combat Training Brigades at Ft. Benning, GA participated. Six companies executed Army qualification at the end of basic rifle marksmanship (BRM) and CFF at the end of advanced rifle marksmanship (ARM). Four executed CFF in BRM and executed Army qualification in ARM. Performance data and Soldier interviews revealed the unique dynamics of CFF, differentiating it from Army qualification. Results showed that CFF should be in ARM, as Soldiers were not prepared in BRM for the additional skills and demands required by CFF. Recommended standards were developed for the Expert, Sharpshooter, Marksman, and Unqualified marksmanship categories, TPU (trained, needs practice, and not trained) categories., and Go/NoGo categories.

15. SUBJECT TERMS

basic rifle marksmanship, advanced rifle marksmanship, combat field fire, measuring Soldier performance, marksmanship training, marksmanship qualification, combat fire, marksmanship standards

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The authors extend their sincere appreciation to Colonels Daniel Kessler and Michael Coss, Commanders of the 198th, and 192nd Infantry Brigades respectively, whose Soldiers participated in the research. Members of their Brigade S3 sections were critical to the successful completion of the effort, and supported us from the pilot effort to the final brief to the battalion and company leaders. Colonel Gregory Kane, Commander of the 197th Infantry Brigade, proponent for the marksmanship Field Manual, was central to initiation of the research. These Brigade Commanders worked closely with ARI in the planning stages. The command emphasis they provided throughout the research was invaluable.

In addition, we acknowledge the contributions of the Battalion commanders, the ten Company Commanders and First Sergeants, and the Drill Sergeants who worked with us to ensure data collection efforts were executed successfully. The Drill Sergeants selected excellent Soldiers from their companies to assist us in collecting data on each firing lane.

The Commandant of the Drill Sergeant School, CSM Newsom, made it possible for Drill Sergeant Candidates to fire both scenarios.

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Lastly, we thank the Soldiers who completed the surveys and who agreed to be interviewed. A special thanks is extended to the sixteen Soldiers from each of the ten training companies who greatly expanded the data collection team and provided the firing lane data that constituted the core and unique marksmanship measures for this research.

SOLDIER PERFORMANCE ON A NEW MARKSMANSHIP COURSE OF FIRE

EXECUTIVE SUMMARY

Research Requirement:

Current combat conditions, Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), have stimulated changes in training to better prepare Soldiers for the threats they will face. One such change was an effort by the Infantry School to modify marksmanship training in Initial Entry Training to include a course of fire that more closely represented combat conditions. This new course of fire was called Combat Field Fire (CFF). CFF required Soldiers to change magazines on their own initiative, to react to a simulated malfunction, and to engage multiple target arrays where the closest targets were exposed for a shorter time than the more distance targets and some targets could bob after being hit, requiring multiple target engagements. The firing positions were kneeling, from behind a barricade, and prone unsupported. Soldiers had more rounds than the number of target exposures, and made their own decisions regarding when to engage each target. ARI was asked to determine the standards for this course of fire and whether it should be in the basic rifle marksmanship (BRM) or advanced rifle marksmanship (ARM) phase of marksmanship training. The research was conducted from January-April 2009, with pilot work on data collection procedures conducted from October-December 2008.

Procedure:

Soldiers (approximately 2000) from ten training companies from both the Basic Combat Training and Infantry One Station Unit Training Brigades at Ft. Benning, GA participated. The research design varied two major parameters: the sequence of fire for the current qualification course of fire (called Army qualification or AQ) and CFF, and the marksmanship program of instruction (POI). Two firing sequences were examined: AQ in BRM with CFF in ARM, and CFF in BRM with AQ in ARM. One POI, called Current, included some recently developed training techniques to include 5-round shot groups, a 200-meter zero, and firing from behind barricades. The other POI, called Legacy, was the POI used prior to the Current POI. It involved 3-round shot groups, a 300-meter zero, and no practice with barricade firing. In addition, Drill Sergeant (DS) candidates from the DS School at Ft. Jackson and DSs from the participating companies fired AQ and CFF.

The grouping, zeroing, and downrange feedback periods of marksmanship training were formally observed. Data were collected on the practice and record fire iterations of both AQ and CFF. Sixteen Soldiers from each company were trained on a specially-designed data collection procedure for CFF to record which round was fired at which target, when Soldiers encountered a dummy round and when they changed a magazine, when they failed to fire at a target, and when they had no more ammunition. A sample of Soldiers was interviewed to obtain their reactions to CFF. All Soldiers were surveyed at the completion of marksmanship training.

Findings:

The findings showed that CFF was not the same as AQ. The CFF scenario was found to be more demanding and complex than AQ. Also target engagements were not independent, with performance in a firing table impacting the following firing tables. Thus Soldiers who performed poorly initially could not recover from their initial problems. More Soldiers perceived CFF-specific skills as difficult when firing CFF in BRM than in ARM. In addition, the performance results showed Soldier skill with marksmanship fundamentals was required but not sufficient to do perform well on CFF.

More Soldiers found CFF-specific skills difficult when they fired CFF in BRM than in ARM. In addition, Soldiers in the Legacy POI had higher scores on AQ when executed in BRM than Soldiers in the Current POI. By contrast, Soldiers in the Current POI had higher scores on CFF when executed in BRM than Soldiers in the Legacy POI. Consistent with these data and the Army's training crawl, walk, run philosophy, the recommendation was to include CFF in the ARM phase of training.

CFF cut-points, established for the marksmanship categories of Expert, Sharpshooter, Marksman and Unqualified, were based on the corresponding percentages achieved in AQ for each of the ten companies. The company cut-points were generally consistent despite variations in AQ performance. Other standards, such as Go/NoGo, were derived from these marksmanship categories.

Procedures developed by ARI for execution of the research proved effective and had training implications. The dummy round loading procedure to ensure random distribution of these rounds across Soldiers was effective. The lane observations showed that to improve CFF performance, Soldiers need to practice integrating the skills required by CFF. DSs need to monitor Soldier performance while firing, as problems cannot be identified by simply knowing which targets a Soldier does not hit.

Utilization and Dissemination of Findings:

The Commanders of the 192nd, 197th, and 198th Infantry Brigades, the sponsors of the research, were briefed on the findings. ARI also briefed the Assistant Commandant of the US Army Infantry School (USAIS), and participated in a briefing by the Commander 197th Infantry Brigade to the Commanding General, USAIS. Feedback was provided to the Battalion Commanders and company leaders of the units who participated in the research, and to the Commandant of the Drill Sergeant School.

The research sponsors accepted the recommendation that CFF should occur in the ARM phase of marksmanship training as well as the guidelines for CFF standards. This information is being used by leaders as they make final decisions regarding the role of CFF in the marksmanship FM and the marksmanship POI. New marksmanship strategies being implemented in 2010 include CFF as the culminating exercises in advanced rifle marksmanship training.

SOLDIER PERFORMANCE ON A NEW MARKSMANSHIP COURSE OF FIRE

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Soldier Performance on a New Marksmanship Course of Fire

Background

Soldiers must qualify with their assigned weapon in basic training and in their unit. This is not a new requirement as it has existed from at least the 1940s. The qualification course, often called record fire, as well as the associated standards of performance, is documented in marksmanship field manuals (FMs). Since 1940, there have been at least seven changes to the qualification scenario as documented in marksmanship FMs. The reasons for a change, either to the scenario itself or the standards, are rarely presented in the FMs. However, other documentation often provides insights into the reasons for some changes, such as changes in the weapon itself, target technology, and/or combat requirements.

The research presented in this report is on a proposed course of fire that presents conditions Soldiers encounter in combat operations in Iraq and Afghanistan (Operation Iraqi Freedom [OIF] and Operation Enduring Freedom [OEF]). The U. S. Army Infantry School (USAIS), specifically the 192nd and 198th Infantry Brigades, experimented with different scenarios and determined one that met their requirements and that they wanted to implement. In FY 2009, the Army Research Institute (ARI) was asked to investigate this new course of fire.

The major purposes of the research were to examine, in depth, the characteristics of this proposed course of fire, to establish marksmanship standards of performance and other conditions necessary to ensure consistency in execution of the scenario, and to determine when this course of fire should occur in marksmanship training. The research also generated empirical data to substantiate the recommended standards of performance. The findings were provided to decision-makers at the Infantry School, the Army proponent for marksmanship, to assist their decision regarding whether this new course should be used for marksmanship "qualification" either to replace the Army's current qualification course or to supplement the qualification course. The new course of fire was called combat field fire (CFF).

Rifle Marksmanship Qualification Courses

This section of the report summarizes marksmanship qualification courses, as documented in the Army's training and doctrine literature since 1940. This historical summary illustrates that marksman courses of fire have changed over time and that introducing a new course of fire is not unusual. In addition, the summary illustrates how CFF is consistent with prior record fire courses but also tests a more complex combination of skills.

Not all marksmanship FMs could be obtained, but the review provides a historical perspective of the changes made in each decade since 1940. Skill requirements have evolved with changes in weaponry, the threat, Army policy, and target systems. The FMs examined covered the M1 rifle, M14 series rifle, M16 series rifle, and M4 carbine. In many FMs, alternate qualification courses were cited as options. Only the primary qualification courses are presented here. The FMs (with changes) examined are listed by year of publication in Table 1.

Table 1
US Army Rifle Marksmanship Field Manuals Examined

Title of Field Manual	Date
FM 23-5. *Basic Field Manual U.S. Rifle Caliber.30 M1*	1940
FM 23-5. *U.S. Rifle Caliber.30 M1*	1951
FM 23-5. *U.S. Rifle Caliber.30 M1*	1958
FM 23-72. *Carbine Marksmanship Courses TRAINFIRE I* [a]	1958
FM 23-71. *Rifle Marksmanship*	1966
FM 23-71. *Rifle Marksmanship, Changes 2, 3, 4*	1968
FM 23-8. *M14 and M14A1 Rifle and Rifle Marksmanship*	1974
FM 23-9. *M16A1 Rifle and Rifle Marksmanship*	1974
FM 23-9. *M16A1 Rifle and Rifle Marksmanship, Change 1*	1975
FM 23-9. *M16A1 Rifle and Rifle Marksmanship, Change 2*	1980
FM 23-9. *M16A1 Rifle and Rifle Marksmanship, Change 3*	1983
FM 23-9. *M16A1 Rifle and Rifle Marksmanship, Change 4*	1985
FM 23-9. *M16A1 and M16A2 Rifle Marksmanship*	1989
FM 3-22.9. *Rifle Marksmanship, M16A1, M16A2/3, M16A4 and M4 Carbine*	2003
FM 3-22.9. *Rifle Marksmanship, M16A1, M16A2/3, M16A4 and M4 Carbine, Change 2*	2004
FM 3-22.9. *Rifle Marksmanship, M16A1, M16A2/3, M16A4 and M4 Carbine, Change 3*	2005
FM 3-22.9. *Rifle Marksmanship, M16A1, M16A2/3, M16A4 and M4 Carbine, Change 4*	2006
FM 3-22.9. *Rifle Marksmanship M16-/M4-Series Weapons*	2008

[a] The corresponding FM for the rifle was FM 23-71, *Rifle Marksmanship Course TRAINFIRE I*, dated 1957. A copy of it was not found. As stated in FM 23-72, the concepts in the carbine FM were based on those in the rifle marksmanship FM 23-71.

Two other major research efforts were examined. The first was the TRAINFIRE I research conducted in the 1950s by Human Resources Research Office (McFann, Hammes & Taylor, 1955). The second was work conducted by the ARI in the 1970s-1980s, which resulted in FC 23-11 (USAIS, 1984) *Unit Rifle Marksmanship Training Guide* and impacted FM 23-9 (Department of the Army [DA] 1983; change 3). In addition, the metric system was officially accepted in 1957, and was integrated fully in FM 23-71, dated 1966.

The major requirements to qualify, as described in these FMs, are summarized in this section. In addition, significant changes to qualification that resulted from improved technology, policy changes, and research are presented. More information on each qualification course, including the complete firing tables, is in Appendix A.

Qualification with the M1 rifle. The qualification standards and procedures for the M1 rifle changed with the 1940, 1951, and 1958 versions of FM 23-5. In fact, the 1940 version of FM 23-5 did not cite any performance standards, despite tables labeled "record courses." All target distances were based on the English system of yards and inches. In general, the targets were bullseye targets, scaled to target distance, on a known distance (KD) range. The pop-up silhouette target was not invented until 1955 and not incorporated into qualification courses until the 1960s. Operators in the pits on the KD range scored the targets. Firers were given points, not target hits, with the maximum points being 5 in the center ring of the bullseye (5 points for a hit). Multiple rounds (e.g., 4, 8, 10) were fired on most tables. Firing tables included slow fire, rapid fire, and sustained fire plus others as presented in Table 2. A variety of positions was specified. Target distances were typically 200 yards and beyond except for 1000 inch and 15 to 35 yard distances used in rapid fire or quick fire tables. Table 2 summarizes the M1 rifle record fire courses.

Table 2
Summary of Record Fire Courses in FM 23-5

Version of FM 23-5		
1940	1951	1958b
Slow Fire Untimed, typically 200 yards, plus 300 yards and 1000 inches from standing, sitting, kneeling prone positions	Slow Fire 10 min per target (12 min for 500 yards) Targets at 100/200/300/500 yards, from standing, kneeling/sitting/squatting, and prone positions Total of 42 rounds: 8 rounds per target except for 10 rounds for 500 yard target	Slow Fire and Rapid Fire Slow Fire: 8 min, 4 targets at 100/200/500 yards, 8-9 rounds, standing, kneeling, and prone. Rapid fire: 50 sec, 2 targets, 9 rounds, 200 & 300 yards, Sitting and prone. Total of 250 points; 50 rounds Points for Qualification: Expert: 212 points Sharpshooter: 187 points Marksman: 160 points
Rapid Fire Timed as 60, 65, and 30 sec. Target distances & positions similar to Slow Fire	Sustained Fire 50 seconds with 9 rounds, at 200 and 300 yards; Standing and squat/sit/kneel Total of 18 rounds	Three other tables to confirm qualification. Minimum points required on each. The three tables used for confirming qualification are cited below.
	Transition Firing 10 target lanes each with a different firing position (e.g., standing, foxhole, rubble pile, window, ditch) and two targets in each lane. Soldiers rotated through the lanes. 4 rounds and 60 seconds per lane. Distance of the paired targets varied considerably, from 125 to 500 yards. Total of 40 rounds.	Combat Position Firing Similar to Transition firing in 1951 FM. Total of 40 rounds 10 lanes, 20 points per lane, total of 200 points. Minimum to confirm qualification - 100 points

Version of FM 23-5		
1940	1951	1958b
	Each hit assigned 5 points; total of 200 points for table.	
	<u>Quick Fire</u> Targets at 15 to 35/45 yards. Firing positions were hip or shoulder. 20 targets over 3 phases. Soldiers had 24 rounds. Silhouette targets exposed for 3-5 sec. Total of 120 points for table.	<u>Quick Fire</u> Similar to Quick fire in 1951 FM, but included friendly targets 28 rounds. 18 silhouette targets plus 3 reaction/friendly targets. 5 points for each hit with 90 points maximum. If all targets hit, 5 points added for each unexpended round. 5 points deducted when hit friendly. Minimum to confirm qualification – 65 points
		<u>Night Fire</u> 25 & 50 yards, 2 targets, 8 rounds per target, total of 16 rounds. 5 points per hit, total of 80 points Minimum to confirm qualification – 25 points
Total # rounds: 184	Total # Rounds: 124	Total # Rounds: 136
No qualification categories presented	Qualification Categories: Expert: 450 points Sharpshooter: 360 points Marksman: 300 points Points cited in FM for only Transition Firing and Quick Fire. Assuming 5 points per hit in Slow Fire and Sustained Fire, maximum possible points would be 620.	Qualification Categories: See Slow and Rapid Fire table above The other tables were used to confirm qualification.

The TRAINFIRE I research (McFann et al, 1955) had several major impacts on marksmanship qualification. The changes stemmed from an intensive review of the skills Soldiers needed in combat, a training program that stressed those skills in order to maximize transfer to combat situations, and a proficiency test of those skills. Major impacts were:

- The pop-up, "killable" target with the M31A1 automatic target device was created in this research program.
- The silhouette targets were olive drab – an effort to "camouflage" the target and have it blend with the terrain of trees and brush.
- Systematic presentation of targets at 50 yard intervals from 50 to 350 yards, to enable more precise measurement of marksmanship skill. Prior to this time, the distances between targets were not systematic.
- There was a shift to having two types of firing positions: supported (foxhole or prone) and movement to an unsupported firing position of the Soldier's choice in the proficiency test.

- A moving target was used in the proficiency test.
- Firing tables had eight single exposure targets with one round allowed for each target. Prior to this time, Soldiers fired multiple rounds at each bullseye target. The exposure times were 5 seconds for targets from 50 to 200 meters and 10 seconds for targets beyond 200 meters. These exposure times of 5 and 10 seconds remained in later FMs until Change 3 to FM 23-9 (DA, 1983).
- The proficiency test range was "natural" terrain.

The two FMs which immediately followed the TRAINFIRE research and had TRAINFIRE I in their titles [(FM 23-71 (1957, *Rifle Marksmanship Course TRAINFIRE I*), and FM 23-72 (1958a, *Carbine Marksmanship Courses TRAINFIRE I*)] incorporated many but not all of the features in the TRAINFIRE proficiency test. The pop-up "killable" target was used but there were no moving targets. For the carbine, targets only went to 200 meters, were exposed for 5 seconds, and the increment between targets was 50 meters. The technique of having a firer move out upon command and then fire from an unsupported position after detecting a target was introduced. It appears that these two FMs were interim FMs which served to document the TRAINFIRE research outcomes in the Army's training and doctrine literature.

Qualification with M14, M16E1 and M16A1 rifles. The TRAINFIRE research (McFann et al., 1955) continued to influence the marksmanship qualification courses cited in the FMs published after the 1950s. The qualification course included many features of the TRAINFIRE proficiency test, but did not replicate it. A major effect of the automatic pop-up silhouette target developed during the TRAINFIRE research was that exposure times were controlled by the target itself rather than by an individual who gave commands to start and stop firing. The other major change resulting from this technology was a switch to single, short-timed exposure targets and to double and triple target exposures. The change to 50-meter increments in target distances, with targets placed on natural terrain, was also incorporated in these FMs. Multiple tables with 8 targets each were initially included in the next series of FMs. Later, these tables were expanded to 10 and 20 targets. Scores were based on the number of silhouette target hits. In addition, the firing positions were described as supported or unsupported. Thus the 1966 version of FM 23-71 for the M14 rifle more closely approximated the current record fire (DA, 2008, FM 3-22.9) qualification courses than the FM 23-5 series with the M1 rifle. However, the requirement to move toward the next target and assume a firing position of choice in FM 23-71 (DA, 1966, 1968) is not in the current record fire.

FM 23-71 (DA, 1966) for the M14 rifle (adopted by the Army in 1957) used the M31A1 target device, but it was mechanically controlled, not computer-controlled. Hits and misses were hand scored. The tables in this FM were quite similar to those cited in FM 23-9, dated 1974. Two exceptions were the addition of quick fire targets and night fire in FM 23-9. Table 3 summarizes the courses in these two FMs. Of interest is that FM 23-9 (DA, 1974b, M16A1 rifle) included three firing tables, with qualification standards based on the Soldier's cumulative performance across all tables. However, before progressing to the next table, a Soldier was to meet a minimum standard of performance. FM 23-8 (DA, 1974a) for the M14 rifle used the same record fire course as FM 23-9 for the M16A1 rifle.

Table 3
Summary of Record Fire Courses in FM 23-71 (1966) and FM 23-9 (1974b)

FM 23-71 (1966)	FM 23-9 (1974b)
Record Firing I, Supported Phase 4 tables, each with 8 single, target exposures; "Random" distances to targets ranging from 50 to 350 meters, 50-meter increments. Targets from 50 to 200 meters exposed for 5 seconds. Targets at 250 meters and beyond exposed for 10 seconds Position was foxhole, supported Soldiers rotated lanes as progressed from the 1st to the 4th table. One round allocated per target.	Record Fire I 4 tables, each with 10 targets No target at 350 meters. Two tables were foxhole supported. The other two tables were prone unsupported. The first table within each position was single targets; the second had mainly double target exposures, some triple. Single target exposure times were the same as FM 23-71 (1966). Double target exposures were 10 or 15 seconds dependent on the target array. One round allocated per target. 20 hits required to progress to Record Fire II
Record Firing I, Unsupported Phase 3 tables, each with 8 single exposure targets from 100 to 350 meters. Soldiers fired from position of their choice after given instructions to "move out". There were four additional commands to "move out" within each table.	Record Fire II 4 tables, each with 10 targets. First table from the foxhole supported position, the other three conducted with the "move out" protocol as executed in Record Firing II in FM 23-71 (1966). The first table had single/double/triple targets; the other three tables had single and double targets, one with triple target exposures. The last three tables also had a total of 10 quick fire targets at 25 meters for an exposure time of 3 seconds each. One round allocated per target. Cumulative score of 47 required to progress to Night Fire.
Record Firing II This phase had 3 tables with target arrays of two and three targets, with total exposure times of 10, 15, and 25 seconds depending on the array. Total of 28 targets. Soldier had 40 rounds (8/16/16). Not given added points for unexpended rounds. Not allowed to carry over unexpended rounds from one table to the next.	Night Fire At 25 and 50 meters; 30 rounds allocated per target. 20 hits required.
Total number of rounds: 96	Total number of rounds: 140 rounds
Maximum possible score: 84 Qualification Categories: Expert: 60 points Sharpshooter: 45 points Marksman: 30 points	Maximum possible score: 100 Qualification Categories: Expert: 75 points Sharpshooter: 66 points Marksman: 54 points

Qualification with M16 series rifle and M4 carbine. Change 3 to FM 23-9, dated 1983, incorporated a major change to the record fire course. It had only 40 targets with four tables of 10 targets each; two tables with the foxhole supported position and two with prone unsupported. Firers were issued one 10-round magazine for each table. There was no "move

out" phase, no night fire, and no triple target arrays. Single target exposure times were specific to the target distance, starting with 3 seconds for the 50-meter target and incrementing by 1 second for each 50 meters up to 8 seconds for the 300-meter target. In previous versions of this FM, targets from 50 to 200 meters were exposed for 5 seconds; targets at 250 and 300 meters were exposed for 10 seconds. The number of targets at each distance also changed to 5 targets at 50 meters, 9 at 100 meters, 10 at 150 meters, 8 at 200 meters, 5 at 250 meters, and 3 at 300 meters. In contrast, for the qualification course in the previous version of FM 23-9, the number of targets at each distance was almost identical (see Table A-6, Record Fire I).

Qualification standards were changed as there were only 40 targets in the revised record fire course. Standards were based on number of target hits, being 36-40 hits for Expert, 30-35 hits for Sharpshooter, and 23 to 29 hits for Marksman.

The next version of FM 23-9 (dated 1989) had the same scenario, but was configured as two 20-target tables, and Soldiers were issued two 20-round magazines. Standards were the same as in Change 3 to FM 23-9 (1983). This qualification scenario was in effect with FM 2-22.9 as well (DA, 2003, 2004, 2005), until Change 4 of FM 3-22.9 which occurred in 2006.

The 1983 changes in the scenario for the record fire course and in the standards cited above resulted from the marksmanship research conducted by ARI in the late 1970s and 1980s (Maxey & Dempster, 1985; Maxey, George & Strasel, 1985; Osborne, Schroeder & Heller, 1984: Osborne & Smith, 1985, Smith Osborne, Thompson & Morey, 1980, USAIS, 1984). It is important to note, however, that no documentation was found that explained why the total number of rounds for record fire was reduced for 140 to 40. In 1978 and 1988, Maxey and Dempster, and Maxey et al. examined the record fire courses used at the Army Training Centers (ATCs). They found differences in these courses. Based on their documentation, it appears that some ATCs were using Record Fire I only (40 targets) as cited in FM 23-9 (DA, 1974); others were using Record Fire I and II in the same FM (see Table 3 and Table A-6). However, since the FM only cited a minimum passing score for Record Fire I and II firing tables, cut-points for Sharpshooter and Expert categories did not exist for these tables. From the documentation provided in Maxey and Dempster, and Maxey et al.[1], the ATCs apparently established their own cut-points for marksmanship categories. The most commonly used set of cut-points for 40 targets (apparently Record Fire I, see Table 3) was Marksman 17-23, Sharpshooter 24-27; and Expert 28-40.

Field Circular 23-11 (USAIS, 1984), which is the same as the Osborne & Smith (1985) report, cited these ATC cut-points as the "old" standards, and contrasted them with the new standards of 23 for Marksman, 30 for Sharpshooter, and 36 for Expert. This comparison of "old" and "new" standards was repeated in FM 23-9 (DA, 1989) and FM 3-22.9 (DA, 2003). Osborne et al. (1984) provided more insight into the changes in standards and the record fire scenario that resulted from the ARI research on rifle marksmanship programs of instruction. "Record fire represents a significant increase in marksmanship standards: from 17 to 23 of 40 to qualify and from 28 of 40 to 36 of 40 to receive an expert badge. Six of the 40 targets were moved to a closer range; however, target exposure time was reduced by an average of 30% (p. 6)."

[1] The complete record fire tables used by the ATCs were not presented in these reports.

The qualification scenario cited in FM 23-9, Change 3 (1983) was also in effect with all following FMs until Change 4 of FM 3-22.9 in 2006. The scenario in Change 4 of FM 3-22.9 (2006) is in the current FM 3-22.9 (2008). In Change 4 of FM 3-22.9 (2006), the first 20-target table, supported position (prone or foxhole), remained the same. However, the last firing table was divided into two tables of 10 targets each. The second table was specified as prone unsupported with targets from 150 to 300 meters and three sets of two targets. The third and last table was unsupported kneeling with single targets at 50, 100 and 150 meters. Target exposure times for firing tables 2 and 3 were adjusted to the target distance. The kneeling unsupported position was included and may have been a result of the Army's Warrior Tasks and Battle Drills initiative that occurred in September-November 2003 which re-examined the basic requirements for new Soldiers. Qualification standards remained the same. Table 4 summarizes these versions of the 40-round, 40-target qualification course.

Table 4
Summary of Record Fire Courses in FM 23-9 (Change 3, 1983), FM 23-9 (1989), FM 3-22.9 (2003), FM 3-22.9 (Change 4, 2006) and FM 3-22.9 (2008)

FM 23-9, Change 3, 1983	FM 23-9 (1989) FM 3-22.9 (2003)	FM 3-22.9 (Change 4, 2006) FM 3-22.9 (2008)
4 tables, each with 10 targets. 2 tables fired from foxhole supported position; 2 tables fired from prone unsupported position Total of 18 single target exposures; remainder were 11 pairs of targets. Distance to targets ranged from 50 to 300 meters. Single target exposure times ranged from 3 sec to 9 sec with exposure time directly correlated with target distance. Exposure times were from 6 to 12 seconds for target pairs . Firer had four 10-round magazines One round allocated per target	Same scenario as FM 23-9, Change 3 Tables were consolidated to 2 tables with 20 targets each. Table 1 was fired from foxhole supported position. Table 2 was fired from prone unsupported position. Firer had two 20-round magazines. One round allocated per target.	3 tables. Table 1 was prone supported, but was the same scenario as the foxhole supported in FM 23-9 (1989) & FM 3-22.9 (2003). 12 single targets from 50 to 300 meters, exposure times from 3 to 8 sec. Four paired targets. Table 2 was prone unsupported with 10 target exposures, from 150 to 300 meters, with 4 single targets (6-8 sec exposure) and 3 paired targets. Table 3 was kneeling unsupported, with all single targets ranging from 50 to 150 meters (4 to 8 sec exposure). Firer had one 20-round magazine, and two 10-round magazines. One round allocated per target.
Total number of rounds: 40	Total number of rounds: 40	Total number of rounds: 40
Maximum possible score: 40 Qualification Categories: Expert: 36-40 Sharpshooter: 30-35 Marksman: 23-29	Maximum possible score: 40 Qualification Categories: Expert: 36-40 Sharpshooter: 30-35 Marksman: 23-29	Maximum possible score: 40 Qualification Categories: Expert: 36-40 Sharpshooter: 30-35 Marksman: 23-29

Summary of qualification courses. Record fire courses evolved with time. The total number of rounds varied with the scenarios fired. The highest number of rounds was approximately 200 for the M1 rifle (FM 23-5, DA, 1940). FMs published in the 1960s and 1970s had courses with approximately 100 rounds, and incorporated basic tables followed by more challenging tables. It was with Change 3 to FM 23-9 (DA, 1983), that a 40-round, 40-target scenario was adopted and the number of rounds has stayed at 40 since that time. The 40-round, 40-target scenario changed to the current version with Change 4 to FM 3-22.9 (DA, 2006).

The Marksmanship categories of Expert, Sharpshooter, Marksman and Unqualified have existed since the 1951 version of FM 23-5 (M1 rifle). One way of comparing the standards for the marksmanship categories is to determine the percentage of total score represented by each cut-point, whether the record fire was based on points or hits. These results are in Table 5.

Table 5
Marksmanship Category Cut-points Expressed as a Percentage of Total Score (1951 to 2008)

Marksmanship Category	Marksmanship Field Manual				
	FM 23-5 (1951)	FM 23-5 (1958)	FM 23-71 (1966)	FM 23-9 (1974b)	Current FM 23- 9 Change 4 (1983) and later FMs
Expert	73% (450 pts)	85% (212 pts)	71% (60 hits)	75% (75 hits)	90% (36 hits)
Sharpshooter	58% (360 pts)	75% (187 pts)	54% (45 hits)	66% (66 hits)	75% (30 hits)
Marksman	48% (300 pts)	64% (160 pts)	36% (30 hits)	54% (54 hits)	58% (23 hits)
Maximum Score/Hits	620	250 (Slow & Rapid Fire)	84	100	40

Notes.
FM 23-5 (1951). Percentages assume 620 points maximum; 5 points per hit in all tables; KD firing.
FM 23-5 (1958). Percentages based on slow and rapid fire tables (KD) only, which were used to establish marksmanship categories. The three tables that followed were used to "confirm" the qualification achieved in the slow and rapid fire tables.
FM 23-9 (1974). Percentages based on the cumulative requirements of the 3 firing tables. However, in the first table, 20 hits (50%) required to progress to the next table. In the second table, cumulative of 47 hits (59%) required to progress to the third table (night fire).

All M1 firing was KD, as the popup killable target (M31A1) was not created until the mid-1950s as a result of the TRAINFIRE project and was not included in record fire courses until later (documented in FM 23-71, DA, 1966). Originally the mechanism was mechanically controlled; it is now computer controlled. KD ranges still exist and are used in training, although some installations also have location of misses and hits (LOMAH) technology. LOMAH provides the firer immediate electronic and pictorial feedback of the location of both target hits

and misses. Another major change from the TRAINFIRE project was incorporating targets at systematic increments from the firer (initially 50 yards, and then 50 meters when the Army changed to the metric system).

Army M16/M4 Record Fire Course and Standards as of 2009

The record fire course Soldiers fired in the current research effort was the same as that in FM 3-22.9 (DA, 2008). The course is presented in full in Table 6 below. Standards are Expert 36-40; Sharpshooter 30-35; Marksman 23-29; Unqualified below 23.

Table 6
Record Fire Table in FM 3-22.9 Rifle Marksmanship M16-/M4- Series Weapons (2008)

Table 1 Prone Supported or Foxhole Supported				Table 2 Prone Unsupported		Table 3 Kneeling	
Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)
50	3	100		200	6	150	8
200	6	200	8	250	8	50	4
100	4	150	10	150	6	100	5
150	5	300		300		150	6
300	8	100	9	200	10	100	5
250	7	250		150		50	4
50	3	200	6	200	12	100	5
200	6	150	5	250		150	6
150	5	50	6	150	9	50	4
250	7	100		150	6	100	5

Note. Based on DA Form 3595-R, September, 2008

Combat Field Fire

The course of fire examined in the current effort, called Combat Field Fire (CFF), is depicted in Figure 1 and described in more detail in Table 7. There were three firing tables: kneeling, barricade and prone, which were executed in that order. Within each firing table, there was either a single array of targets or two target arrays. Also within each array, selected targets required multiple hits. These targets "bobbed" after being hit once and came back up, requiring the Soldier to engage the target again. A target kill was defined as when a Soldier achieved the required number of hits on a target. Considering all firing tables, 5 targets were exposed once requiring only 1 hit for a "kill", 9 targets were exposed twice (bobbed) requiring 2 hits for a "kill", and 1 target was exposed 3 times (bobbed) requiring 3 hits for a "kill". One point was assigned to each hit, with an additional three points assigned for a kill. In total, the maximum of number of hits was 26, which reflected the number times a target could bob. The maximum number of points was 71, which reflected the number of hits plus the additional points for each kill. The point system was investigated because the Infantry School wanted to determine if getting additional points for a kill motivated Soldiers.

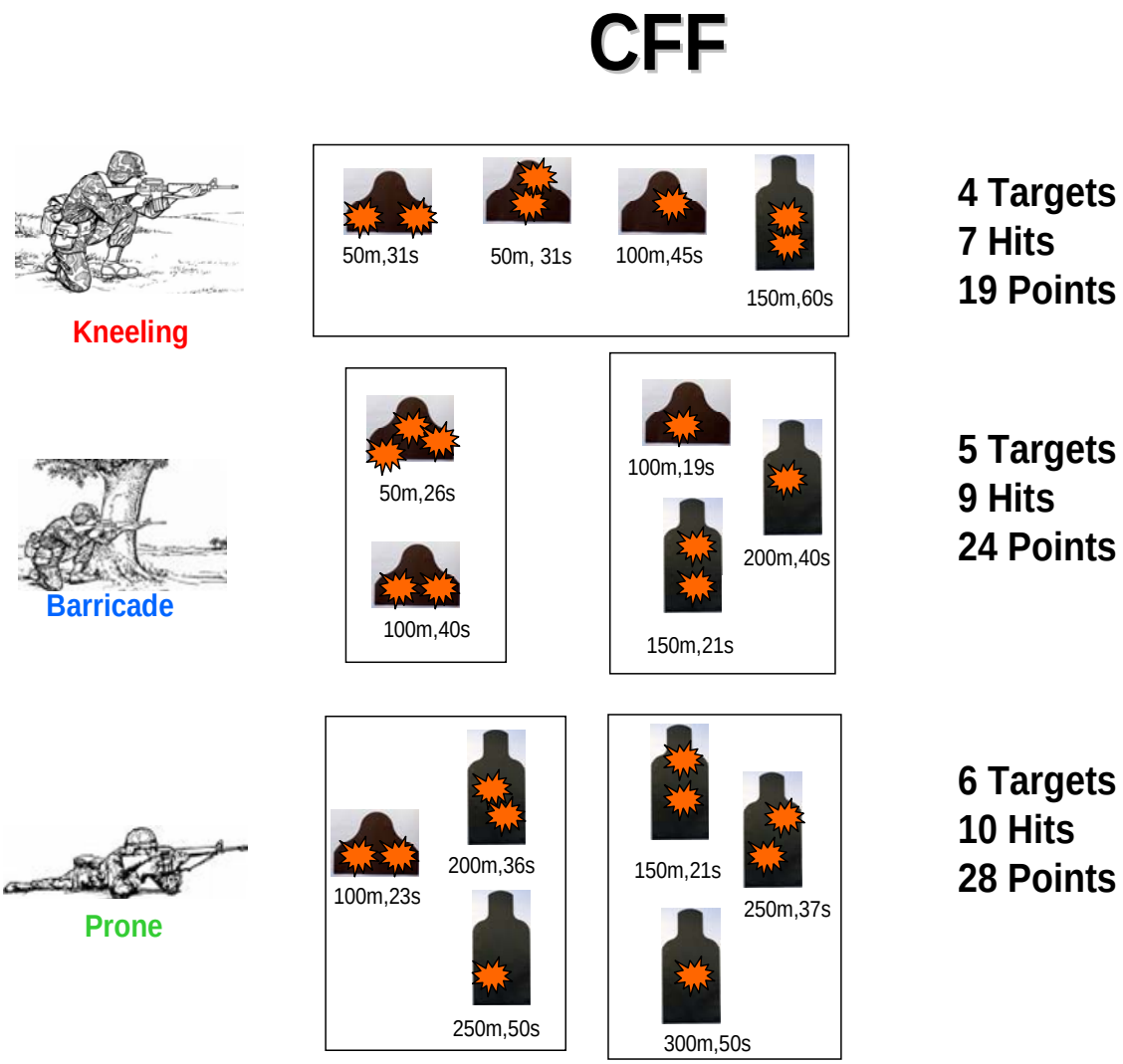

Figure 1. Combat field fire. (Starburst graphics on each target indicate the hits required for a kill. Targets which require multiple hits for a kill "bob" after each hit; they are not static. Total of 15 kills; one kill per target.)

Table 7
Combat Field Fire Scenario and Scoring Procedures

	Target Distance in Meters	Target Exposure Time	# Hits to Kill (Targets w multiple hits bob after each hit)	Maximum Points w Kill	Maximum # Hits
Firing Table 1 – Kneeling Unsupported					
Four targets exposed at once for 60 total seconds					
	50m left	Drops after 31 Sec	2	5	2
	50m right	Drops after 31 sec	2	5	2
	100m	Drops after 45 sec	1	4	1
	150m	Drops after 60 sec	2	5	2
Cumulative				*19*	*7*
Firing Table 2 – Barricade Supported					
First target exposures for 40 seconds					
	50m L or R	Drops after 26 sec	3	6	3
	100m	Drops after 40 sec	2	5	2
Second target exposures for 40 seconds					
	100m	Drops after 19 sec	1	4	1
	150m	Drops after 21 sec	2	5	2
	200m	Drops after 40 sec	1	4	1
Cumulative				*24*	*9*
Firing Table 3 – Prone Unsupported					
First target exposures for 50 total seconds					
	100m	Drops after 23 sec	2	5	2
	200m	Drops after 36 sec	2	5	2
	250m	Drops after 50 sec	1	4	1
Second target exposures for 50 seconds total					
	150m	Drops after 21 sec	2	5	2
	250m	Drops after 37 sec	2	5	2
	300m	Drops after 50 sec	1	4	1
Cumulative				*28*	*10*
Grand Total				71	26

Within each array, all targets were exposed initially, but dropped at different times; the closest target within the array dropped before the farther targets. Thus it was possible for Soldiers to fail to fire at a target because the target's exposure time had elapsed. The total exposure time for a target that bobbed included the time required to mechanically drop and reset the target. The exact times are shown in both Figure 1 and Table 7.

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Soldiers had three magazines, each with ten live rounds and one dummy round.[2] The purpose of the dummy round was to simulate a malfunction, which then required immediate action procedures on part of the Soldier. The dummy round was to be randomly placed in each magazine so a Soldier could not anticipate when it would occur. But it could not be either the

[2] Cartridge used was: 5.56mm dummy M199 (DODIC A060).

first or the last round. The 30 live rounds meant that the Soldier had 4 additional live rounds, as only 26 hits were required to achieve a maximum score. Targets were closest in the kneeling firing table, progressing to the farthest distances in the prone firing table.

Each Soldier determined when to change magazines. Changes were not directed "by the tower" as is typically the case with record fire courses, where Soldiers are directed to change their magazines between firing tables. The time between the firing tables varied with the computer processor and software on each range, but typically was about 10 seconds.

Based on the review of previous marksmanship FMs, there were historical precedents for certain elements of CFF. These elements were:

- Use of barricade and other obstacles for firing position: FM 23-5 (1951; 1958, M1 rifle).
- More rounds than targets: FM 23-71 (1966, M14 rifle).
- Target array – maximum of 3 targets; FM 23-71 (1966, M14 rifle); FM 23-9, (1974, M16A1 rifle).

However certain elements of CFF were never included in prior record fire courses. Thus no prior scenario incorporated all the factors in CFF. Elements not included were:

- Inducing a malfunction with a dummy round.
- Targets within an array that could "bob" and were exposed for different periods of time.
- More than one magazine change required / integrated across firing tables.

The phrase "combat fire" was used to name a training exercise (not record fire) in FM 23-9 (DA, Change 3, 1983). This exercise involved a magazine change and 5 more rounds than targets in each of two 20-target exposure scenarios.

Also of interest is that all record fire courses included firing tables that focused on the basics of shooting. When additional tables were included, they focused on more complex marksmanship skills relevant to that time period and existing target/range technology. These more advanced skills are listed below. None are included in CFF.

- Night fire: FM 23-5 (1958, M1 rifle); FM 23-9 (1974, M16A1 rifle).
- Move out, detect target, and fire phase where Soldier assumed a firing position of Soldier's choice: FM 23-71 (1966, M14 rifle); M23-9 (1974, M16A1 rifle).
- Quick fire: FM 23-5 (1951, 1958 M1 Rifle); FM 23-9 (1974, M16 Rifle).
- Friendly targets: FM 23-5 (1958, M1 rifle).

Research Objectives

The research addressed the following issues:

- Determine cut-points for marksmanship categories (Expert, Sharpshooter, and Marksman) for CFF. Cut-points for both the number of hits achieved and CFF points were to be determined.

- Recommend whether CFF is best as a replacement for the current Army Qualification (AQ) course or a supplement to AQ in Initial Entry Training (IET). Recommend whether CFF should be in Basic Rifle Marksmanship (BRM) or Advanced Rifle Marksmanship (ARM).
- Determine the relative effectiveness of the Current and Legacy marksmanship training programs based on Soldiers' performance on their first attempt at "record fire" for both AQ and CFF.

Method

Participants

Ten initial entry training (IET) companies from Ft. Benning, GA participated. Six were Infantry One Station Unit Training (OSUT) companies, and four were Basic Combat Training (BCT) companies. These companies came from the two training brigades at Ft. Benning. Company size ranged from 152 to 235. All Soldiers were male. In addition, a sample of the drill sergeants (DSs) from the participating companies, and DS candidates from Ft. Jackson, SC fired the two courses of fire to provide a comparison of performance with the Soldiers in training. All DSs were male; the DS candidates were male and female.

Research Design

Two marksmanship programs of instruction (POIs) were compared, called Current and Legacy, with five companies per POI. The two POIs are described below. In summary, within each POI, two sequences of fire were executed which reversed the sequence of firing AQ and CFF: AQ in BRM followed by CFF in ARM (AQ first), and CFF in BRM followed by AQ in ARM (CFF first). Both OSUT and BCT companies were in each POI and firing sequence combination. This design is shown in Table 8, along with the weapon and sight combinations used by each company. The weapons and sights were organic to each company, and therefore did not represent a change from what Soldiers in each company had in marksmanship training. The number of Soldiers who fired AQ and CFF for each company is also cited. A total of 1976 Soldiers fired AQ; a total of 1820 fired CFF.

Firing of AQ and CFF. Soldiers must qualify as Marksman to graduate from Infantry OSUT and from BCT. The current BRM POI specified that Soldiers could fire two practice record fires before record fire on AQ. This was the case in the research as well, although data were only collected on the first practice record fire, and on the first attempt at AQ record fire. Per each POI, Soldiers who did not qualify the first time were allowed to fire again in order to qualify. Results of this "refiring" were collected, but not analyzed to determine differences in the design variables. Prior to the research, companies only fired CFF once. However, for purposes of the research, each company fired a "practice fire" as well as a "record fire" iteration of CFF to provide an opportunity to practice on CFF, making it more comparable to the experience with AQ. Thus companies fired CFF twice.

Table 8
Research Design and Number of Soldiers in Each Company

Sample Size For Each Course of Fire	**Current Program of Instruction**				
	Sequence of Fire				
	AQ in BRM - CFF in ARM			CFF in BRM - AQ in ARM	
	Weapon Sight Combination				
	OSUT Co M4 Carbine with M68	OSUT Co M4 Carbine with BUIS	BCT Co M16A4 rifle with IS	OSUT Co M4 Carbine with M68	BCT Co M16A4 rifle with IS
AQ	180	177	226	175	202
CFF	165	165	151	174	201
	Legacy Program of Instruction				
	Sequence of Fire				
	AQ in BRM - CFF in ARM			CFF in BRM - AQ in ARM	
	Weapon Sight Combination				
	OSUT Co M4 Carbine with M68	OSUT Co M4 Carbine with BUIS	BCT Co M16A4 rifle with IS	OSUT Co M4 Carbine with M68	BCT Co M16A4 rifle with IS
AQ	190	212	235	152	227
CFF	184	190	230	153	207

Note. M68 is the Close Combat Optic sight. IS refers to an iron sight system. The iron sight on the M16A4 was the carrying handle sight, consisting of a rear sight with an aperture adjustable for elevation and windage, and a fixed front sight post. BUIS refers to Backup Iron Sight, which is a semi-permanent flip-up iron sight equipped with a rail-grabbing base. It is intended to remain on the M4 while the M68 is used as the primary sight. The BUIS can be adjusted for elevation and windage. If the M68 fails, the pre-zeroed BUIS can be flipped up and used to continue the mission. In the research, the BUIS was used on the M4 with no CCO.

To obtain insights regarding how experienced Soldiers would perform on CFF (vice only Soldiers in training), DSs and DS candidates participated. Two to three DSs from each company fired AQ and CFF; 28 fired AQ and 29 fired CFF. The DS candidates also fired both courses of fire; data were available for 89 on AQ and for 86 on CFF.

The companies were selected by their respective commands. All companies fired AQ and CFF on one of two ranges at Ft. Benning. The two ranges had similar terrains, with each being relatively flat with limited to no vegetation.

The legacy and current programs of instruction. The Legacy and Current BRM POIs were comprised of 13 periods of instruction designed to introduce the Soldier to the M16 rifle/M4 carbine rifle. Table 9 lists the BRM periods of instruction in each POI. The current POI included some recently developed training techniques to include 5-round shot groups, a 200-meter zero, and firing from behind barricades. The Legacy POI, was used prior to the Current POI. It involved 3-round shot groups, a 300-meter zero, and no practice with barricade firing.

Table 9
Comparison of Legacy and Current BRM POIs

BRM Period	Legacy BRM POI	Current BRM POI
1	Marksmanship Introduction	Marksmanship Introduction
2	Range Procedures	Range Procedures; Engagement Skills Trainer 2000 (EST)[a]; Introduction to M68 Sight[3]
3	Range Procedures; EST 2000	Range Procedures; EST 2000
4	Grouping	Group and Zero [b]
5	Zeroing	Group and Zero
6	Location of Miss and Hit (LOMAH)	Group and Zero
7	Single timed targets (EST)	100/200 meter M16/M4 Group and Zero
8	Single/Multiple timed targets (EST)	100/200 meter M16/M4 Group and Zero
9	Single timed targets	Location of Miss and Hit (LOMAH)
10	Single/Multiple timed targets	Multiple Timed targets (EST)
11	Practice Fire	Static Target Engagement
12	Practice Fire	Practice Fire
13	Record Fire	Record Fire

[a] The EST 2000 is an indoor, multipurpose, multilane, small arms simulator.
[b] Company divided into 3 groups; with one-third of the company training on grouping and zeroing each day.
Note. Companies grouped and zeroed with the weapon sight combination as cited in Table 8.

The Legacy POI was designed for use with the M16-series rifle and evolved to the outline in Table 9 in parallel with the introduction of the different models of the rifle (M16A1-A4). The Current POI was developed about one and a half years prior to start of the research and designed for use with the M4-series rifle/M4 carbine. It focused on the emerging Combat Assault Rifle Training Course (CARTC) methods of marksmanship (US Army Drill Sergeant School, 2010). As most companies had switched to the Current POI, the four companies assigned to execute the Legacy POI had to change and go back to that mode of training.

The most significant difference when comparing the two POIs is the amount of time and instruction Soldiers received grouping and zeroing their rifle. The Legacy POI allotted one day for a company (up to 240 Soldiers) to group and one day to zero. The Current POI allotted one day to group and zero one-third of a company for a total of three days, followed by two additional days to further refine weapon zeros at 100 and 200-meters. Another difference in the grouping and zeroing process was the number of rounds used. The Legacy POI used 3-round groups where the Current POI used 5-round groups. The 5-round group in the Current strategy was implemented to make triangulation of the shot group more accurate and efficient. The Current POI had Soldiers establish a 200-meter zero with their sights; while the Legacy POI used a 300-meter zero.

[3] The M68 CCO is a reflex (non-telescopic) sight that is designed for the "two eyes open" method of sighting, but can be shot with only one eye open. The red dot aiming point follows the horizontal and vertical movement of the firer's eye, while remaining fixed on the target.

The amount of time and instruction the Soldiers received in preparation for the record fire qualification scenario varied between the POIs. The record fire scenario required a Soldier to engage a total of 40 single and multiple timed exposure targets (exposed from 3-12 seconds) and hit at least 23 out of 40 (see Table 6).

The Legacy POI used the crawl, walk, run technique of introducing the Soldiers to single targets in BRM period 6 before progressing through simulated and live-fire single and multiple timed exposure targets in BRM periods 7 through 10. The companies were then allotted two days of practice fire (BRM 11 and 12) that replicated the record fire scenario before conducting record fire.

The Current POI had limited time available for the Soldier to progress sequentially from single to multiple targets replicating the record fire scenario. The Soldiers were introduced to single targets in BRM period 9 and simulated multiple timed exposure targets in BRM period 10 before reverting back to static iron targets in BRM period 11. The companies were then allotted only one day to conduct practice fire before conducting record fire.

There were some variations in how the two POIs were executed during the research, which was not unexpected given an effort of this size and in some cases necessary because of the research design itself. Three examples are cited. With the companies that had the Legacy POI and the CFF - AQ firing sequence, Soldiers conducted dry-fire exercises from barricades as concurrent training in BRM. This variation in the Legacy POI was allowed to ensure safety during CFF barricade live-fire. Otherwise, this training would have been conducted in ARM. Another variation was that one company in the Current POI zeroed their sights for 300 meters. Lastly, one company in the Current POI used 5 rounds to group and 3 rounds to zero.

Procedures

The research was conducted over a four-month period, from mid January to the end of April 2009. Each company executed BRM and ARM during its normally scheduled training cycle. Pilot research with the data collection instruments occurred in October-December 2008.

All data collection and observations were conducted within the context of each company's training schedule. Training observations were limited to grouping, zeroing, and confirmation of zero periods. Four records of Solder performance were obtained: one practice fire for AQ, the first attempt at AQ record fire, the "practice fire" iteration of CFF, and the last or "record" iteration of CFF.

In addition to practice and record fire scores on AQ and CFF, the actions individual Soldiers took on each lane during the course of fire were documented (e.g., which target was fired at, when a Soldier did not fire). Soldiers from each company were trained to collect these data. More detail on these lane observations is presented in the Measurement section.

A sample of Soldiers was interviewed from each company after firing the last iteration of CFF. All Soldiers completed a survey at the end of ARM.

To ensure companies fired the correct version of CFF, as there were other software versions of CFF available on the firing ranges, a unique name was given to the CFF used in the research: *Approved CQ Scenario KBP*. The phrase "KBP" referred to the order of the tables – kneeling, barricade and prone.

In accordance with protocols for range firing, commands from the tower to the Soldiers on changing firing positions were established. They were brief, consistent with the intent to approximate a combat fire situation. These commands were:

"Assume a good Kneeling position"
"Assume a good Barricade position"
"Assume a good Prone position"

A standing operating procedure for loading the dummy rounds was also created. The intent of the CFF scenario was to have dummy rounds occur at random for each Soldier, and to be equally distributed across all magazines, from the second through the tenth round. During the pilot work, it was determined that without guidance, Soldiers in the ammunition detail typically loaded the dummy rounds as the 5^{th}, 6^{th}, or 7^{th} round. They did not distribute the rounds randomly in the magazines. Consequently, a procedure was developed for the ammunition detail to ensure that rounds were equally likely to occur as the 2^{nd} through the 10^{th} round (could not be 1^{st} or last round per the CFF scenario). This procedure is presented in Figure 2.

The dummy round procedure assumed a nine-man detail. Each individual put a dummy round in a specific and a unique location. This reduced confusion among the individuals in the detail, as each had a specific responsibility. This also ensured that rounds were equally distributed in the 2^{nd} through the 10^{th} positions.

The last step was to "mix-up" all magazines prior to distributing them to the firers. Although this did not guarantee a "random" distribution, it did substantially reduce the likelihood that Soldiers had the dummy round in the same location in all three magazines. On occasion, Soldiers would get magazines with dummy rounds in the same location. However, during the interviews Soldiers indicated that they were not aware of this when they fired CFF.

It was important to mix-up the magazines, as the typical procedure used by the ammo detail is to systematically stack the magazines from one individual in the ammo detail and then add the magazines from the next individual, etc. If this procedure had been followed, most Soldiers would not have received magazines with the dummy rounds in different locations.

Load Each Magazine with 10 live rounds and 1 dummy round
Dummy round CANNOT be the first round or the last round.

	Order of Live Rounds and the Dummy Round										
Mag #	**Rd 1**	**Rd 2**	**Rd 3**	**Rd 4**	**Rd 5**	**Rd 6**	**Rd 7**	**Rd 8**	**Rd 9**	**Rd 10**	**Rd 11**
Mag 1	1	**D**	2	3	4	5	6	7	8	9	10
Mag 2	1	2	**D**	3	4	5	6	7	8	9	10
Mag 3	1	2	3	**D**	4	5	6	7	8	9	10
Mag 4	1	2	3	4	**D**	5	6	7	8	9	10
Mag 5	1	2	3	4	5	**D**	6	7	8	9	10
Mag 6	1	2	3	4	5	6	**D**	7	8	9	10
Mag 7	1	2	3	4	5	6	7	**D**	8	9	10
Mag 8	1	2	3	4	5	6	7	8	**D**	9	10
Mag 9	1	2	3	4	5	6	7	8	9	**D**	10

Mag 1: 1 live round then the dummy round
Mag 2: 2 live rounds then the dummy round
Mag 3: 3 live rounds then the dummy round
Mag 4: 4 live rounds then the dummy round
Mag 5: 5 live rounds then the dummy round
Mag 6: 6 live rounds then the dummy round
Mag 7: 7 live rounds then the dummy round
Mag 8: 8 live rounds then the dummy round
Mag 9: 9 live rounds then the dummy round

Figure 2. Dummy round loading procedures.

Measures

Training observations. The grouping, zeroing, and confirmation of zero training periods were observed for each company. The data form used for these periods for a single company is at Appendix B. Grouping and zeroing were conducted on a 25-meter range. Confirmation of zero was executed either on a LOMAH instrumented range or on a KD range.

AQ and CFF scores. The number of hits obtained during AQ and CFF were obtained from the range printouts. For AQ, the company cadre provided feedback on hits and marksmanship categories to the Soldiers after each firing order. For analytic purposes, both the number of hits and the marksmanship categories were examined.

For CFF, total hits was one of two measures analyzed. The other was total CFF points which assigned three additional points when a kill was achieved on a target (see Table 7). Hits were on all range print outs, but total points was not computed on all ranges, nor was the total number of kills. Consequently for consistency across companies, after Soldiers fired CFF, they only received immediate feedback on the number of CFF hits from the company cadre. In addition, Soldiers did not receive any feedback on CFF standards (e.g., "qualified" vs "unqualified") as standards had not been developed prior to the research.

Lane observation sheets. Paper and pencil lane observation sheets were developed to document each Soldier's behavior on both AQ and CFF. These were developed for two reasons. First, a zero on the CFF printout was ambiguous. It could mean that the Soldiers fired and missed, that they failed to fire even though ammunition was available (called a no fire), or that the Soldier had no more ammunition. Second, one objective of the research was to document the shooting patterns associated with the marksmanship categories that were to be established. This information would provide decision-makers additional information to help them decide the appropriateness of the cut-points.

Several versions of the CFF lane observation sheet were piloted with other companies who conducted CFF prior to the research. During the pilot work, a form was developed that could be used by Soldiers with minimal training and that contained the critical CFF data elements. The form was used to document which round was fired at which target, when simulated malfunctions (dummy rounds) occurred, when a Soldier changed magazines, and when there was no ammunition available. When a Soldier had an actual weapon malfunction, not a simulated malfunction induced by the dummy round, the observers made a distinct note to that effect on the observation sheet. Rounds fired were documented as 1 through 11 for each magazine; yielding three sets of numbers from 1 through 11. The form was not used to record if a target was hit. The final form is in Figure 3.

Sixteen Soldiers from each company served as data collectors and were trained on CFF data collection procedures during practice fire on CFF. They fired in the first orders, received training on the form, and collected data on about three to four Soldiers each. Then they received feedback on the data they recorded. The final phase of training was to collect data on about three to four more Soldiers followed by a final round of feedback. During CFF record fire, they fired in the first order. They received final instructions on the forms, and collected data on all the remaining Soldiers in the company.

Roster #_____ Lane_____ Firing Order _____

	<u>Every time</u> a Soldier fires at a target, record the # of that round in the appropriate cell. Record the # no matter whether he hits or misses. ***Round #s start at "1" with each magazine and end with "11."*** ***Write in the words "Mag Chg" when changed magazines.***	**Record the round # where a malfunction occurs**
EXAMPLE: POSITION A**		
75 m (2)	1 2 3	5
175 m (2)	4 6	
275 m (1)	7 8	
Kneeling		
50m L (2)		
50m R (2)		
100m (1)		
150m (2)		
Barricade		
50m L/R (3)		
100m (2)		
[Pause in Scenario]		
100m (1)		
150m (2)		
200m (1)		
Prone		
100m (2)		
200m (2)		
250m (1)		
[Pause in Scenario]		
150m (2)		
250m (2)		
300m (1)		
Were there any rounds remaining in the last magazine?		Yes No

** Example: From Position A, the 1st, 2nd and 3rd rounds were fired at the 75m target. The 4th round was fired at the 175m target. On the 5th round the Soldier had a malfunction. The 6th round was fired at the 175m target. The 7th and 8th rounds were fired at the 275m target.

Figure 3. CFF lane observation sheet.

Soldier questionnaires. Soldier questionnaires obtained the Soldiers' reactions to their training, the perceived differences in the AQ and CFF scenarios, what skills needed more practice, confidence in marksmanship skills produced by the two scenarios, and their general reactions to their overall marksmanship proficiency. During the pilot work, two forms of the questionnaires were tested with a training company just prior to their graduation from OSUT. In one, most questions were in a nine-point behaviorally anchored format. In the other, most questions were in a "Yes/No" format. The "Yes/No" format was used, as a comparison of the two formats showed it yielded more consistent results.

All Soldiers in the ten companies received the questionnaire at the end of their training, that is, after they fired the last "record fire" whether it was AQ or CFF. If taken on the day of AQ, Soldiers completed it only after they had qualified, not before. The final questionnaire, with Soldier responses, is at Appendix C.

Soldier CFF interviews. About 20 Soldiers from each company were interviewed, by the same member of the research team, after they completed CFF. The intent of the interviews was to better understand what Soldiers did during CFF. Different procedures were used to select Soldiers. Sometimes, the procedure was simply to select Soldiers in groups of three or four by lane number. In other cases, it was by number of hits (high through low). For each interview, the interviewer referred to the lane observation sheet obtained for that Soldier.

Questions were directed toward the shooting patterns shown on that sheet and tailored to the Soldier. For example, if a Soldier fired many times at a target, the interviewer asked if the Soldier was aware of this, and why the repeated firing. Other questions might be whether a Soldier was aware of being low on ammunition. If a Soldier performed well, a typical question was to explain that performance, and whether any aspect of the CFF was particularly challenging. The interviews also focused on anomalies that occurred. For example, the interviews revealed that short Soldiers often had difficulties getting a stable position and a good sight picture in the barricade position (reference CFF firing table 2). It was through the interview process that it was discovered that some Soldiers positioned themselves behind the barricade in the kneeling position (reference CFF firing table 1) such that they were unable view their entire sector of fire and see both 50m targets. A common question was how Soldiers perceived the pace of the scenario, e.g., too fast, too slow, or about right.

Input from Company Commanders. After the companies completed their training, company commanders provided input on the company that participated in the research and the experience of the company's training cadre. The specific information requested is at Appendix D.

Analysis

Determining marksmanship categories for CFF. The procedures for determining marksmanship category cut-points assumed the Army was satisfied with the current cut-points on AQ for Expert, Sharpshooter, and Marksman. Typically within IET, there is a small percentage of Experts with Marksman constituting the largest percentage. The basic procedure was to determine the percentage of Soldiers who qualified on their first attempt at AQ as Expert, Sharpshooter, and Marksman, and those who did not qualify on their first attempt. This AQ percentage template was then applied to the distributions of CFF hits and points. When an exact match could not be made, the closest approximation was used.

This procedure was iterated thirteen times. It was done for each of the ten companies, using the unique distribution of Soldiers on AQ for each company. The result of this process was a set of CFF cut-points specific to each company. Then all Soldiers were pooled and the same process was applied to the pooled sample. Cut-points from the pooled sample were used as the recommended divisions between marksmanship categories. The last step was to determine whether the cut-points replicated in the DS and DS candidate samples.

This procedure yielded consistent results despite variations in company expertise. Other techniques such as cluster analysis and establishing cut-points for each firing table within CFF were tried. However, they did not produce distinct clusters or scores consistent with total hits.

Coding CFF shooting patterns. Another major phase of the analysis was to describe the shooting patterns of the Soldiers during CFF and determine the relationship between these patterns and the marksmanship categories that were established. As stated previously, the CFF course of fire required Soldiers to 'kill' targets by hitting them a predetermined number of times (ranging from 1 to 3 hits). CFF also required Soldiers to deal with simulated weapon malfunctions caused by dummy rounds and with multiple magazine changes. To fully understand these behaviors, the lane observation sheets (Figure 3) were then augmented with the data collected from the range towers, which only indicated how many times a target had been hit.

As stated previously, observers recorded the sequence of events by numbering the shots fired from a magazine as 1 through 11. This sequence occurred 3 times, as each Soldier had 3 magazines, each with 10 live rounds and 1 dummy round. To understand how the observers recorded the behaviors, consider the example completed lane observation sheet shown in Table 10.

Table 10
Example of Completed CFF Lane Observation Sheet

Target Distance	Round # used to engage each target (#s 1-11 for each magazine) *"Mag Chg" when changed magazines.*	Round # where a malfunction occurred
Kneeling		
50m L	*2; 4*	*6 DR*
50m R	*1; 5*	
100m	*3*	
150m	*7; 8; 9; 10; 11; Mag Chg*	
Barricade		
50m L/R	*1; 4*	*6 DR*
100m	*2; 3; 5*	
	[Pause in Scenario]	
100m	*7*	
150m	*8; 9*	
200m	*10*	
Prone		
100m	*11; Mag Chg; 1*	*9 DR*
200m	*6; 7*	
250m	*2; 3; 4; 5; 8; 10*	
	[Pause in Scenario]	
150m	*11*	
250m		
300m		
	Rounds remaining? *No*	

Table 10 shows that this Soldier fired the first shot at the 50m right target in kneeling, the second at the 50m left target in kneeling, and so on. The right hand column indicates which round was the dummy (DR). Thus the three dummy rounds were the sixth round in the first magazine, the sixth round in the second magazine, and the ninth round in the third magazine. Magazine changes occurred during the kneeling and prone positions. The last round fired in first magazine was at the 150m target in kneeling; last round in second magazine was at the 100m target in prone; last round in third magazine was at the 150m target in prone. No ammunition remained during the last phase of the prone position.

The Soldiers recording these data did not determine whether a shot resulted in a hit or a miss. Hits and misses were determined post-hoc by matching the observer data with the corresponding tower data for each Soldier. Consider the example in Table 11, which replicates

the lane sheet but adds the necessary information from the tower data in the left column. The two hit columns on the left side of Table 11 indicate that this Soldier achieved 20 of 26 target hits. The shaded rows indicate where the actual hits deviated from the hits required for a kill.

Table 11
Example of CFF Lane Observation Sheet Augmented with Hits Achieved and Required

# Hits Achieved	# Hits Required for a Kill	Target Distance	Round # used to engage each target (#s 1-11 for each magazine) *"Mag Chg" when changed magazines.*	Round # where a malfunction occurred
			Kneeling	
2	2	50m L	*2; 4*	*6 DR*
2	2	50m R	*1; 5*	
1	1	100m	*3*	
2	2	150m	*7; 8; 9; 10; 11; Mag Chg*	
			Barricade	
2	3	50m L/R	*1; 4*	*6 DR*
2	2	100m	*2; 3; 5*	
		[Pause in Scenario]		
1	1	100m	*7*	
2	2	150m	*8; 9*	
1	1	200m	*10*	
			Prone	
2	2	100m	*11; Mag Chg; 1*	*9 DR*
2	2	200m	*6; 7*	
0	1	250m	*2; 3; 4; 5; 8; 10*	
		[Pause in Scenario]		
1	2	150m	*11*	
0	2	250m		
0	1	300m		
20	26		Rounds remaining? *No*	

The combination of observer data and tower data allowed for a more complete description of Soldier performance in CFF. For each target and each Soldier, data were coded as a string variable with seven dimensions.

- Number of hits.
- Number of misses.
- Number of induced malfunctions.
- Number of magazine changes.

- Number of no fires.
- Number of instances where no ammo was available.
- Data missing, indicating that the range software showed a target had been hit more often than a Soldier had fired according to the lane observation sheets.

How these dimensions were coded is illustrated in bold in the fifth column of Table 12. Examine the bold entries for the first 100m barricade target. The tower data showed the target was hit twice, while the observer data showed the Soldier fired three times (rounds 2, 3, and 5). Those three shots are coded '2h1m' for '2 hits and 1 miss.'

Table 12
Example of CFF Codes as Applied to Lane Observation Data on a Soldier (Table 11)

# Hits Achieved	# Hits Required	Target Distance	Round # used to engage each target (#s 1-11 for each magazine) *"Mag Chg" when changed magazines.*		Round # where a malfunction occurred
			Kneeling		
2	2	50m L	*2; 4*	**2h**	*6 DR*
2	2	50m R	*1; 5*	**2h**	
1	1	100m	*3*	**1h**	
2	2	150m	*7; 8; 9; 10; 11; Mag Chg*	**2h3m1malf**	
			Barricade		
2	3	50m L/R	*1; 4*	**2h1nf1magch**	*6 DR*
2	2	100m	*2; 3; 5*	**2h1m**	
		[Pause in Scenario]			
1	1	100m	*7*	**1h1malf**	
2	2	150m	*8; 9*	**2h**	
1	1	200m	*10*	**1h**	
			Prone		
2	2	100m	*11; Mag Chg; 1*	**2h1magch**	*9 DR*
2	2	200m	*6; 7*	**2h**	
0	1	250m	*2; 3; 4; 5; 8; 10*	**6m1malf**	
		[Pause in Scenario]			
1	2	150m	*11*	**1h1na**	
0	2	250m		**2na**	
0	1	300m		**1na**	
20	26		Rounds remaining? *No*		

Malfunctions and magazine changes were coded in accordance with the round that happened *after* the malfunction/magazine change occurred. This was for the simple reason that any effects of those events would be seen in the next observable behavior. An illustration of this can be seen in the coding of the 50m target in the barricade position (see Table 12). Although the magazine change was listed on the lane observation form next to the 150m kneeling target, the next round fired after the magazine change was round 1 from the second magazine, which was fired at the 50m L/R target (barricade position).

Malfunctions were coded by using the dummy round number. As noted, the malfunction code appeared with the shot that was fired next. Consider the bold entry in the 150m Kneeling target. As the dummy round was round number 6, it was coded as a 'malf" along with round number 7 which was fired at 150m kneeling, hence, '2h3m1malf' indicating '2 hits 3 misses and 1 malfunction' (see Table 12).

A no fire ('nf') indicated when a Soldier fired fewer shots at a target than required to kill the target. Because of this operational definition, a no fire occurred when a target was not killed. An example of a no fire can be seen in the 50m L/R barricade target in Table 12. Three hits were required to 'kill' that target. The Soldier fired twice and hit twice, but failed to fire the required third shot yielding a code of '2h1nf."

No ammo ('na') indicated that a Soldier failed to fire at a target because no ammunition was available. As with the no fire code, this code was used only when a target was not fired at enough times to kill that target. Again, as with no fire, no ammo occurred only when a target was not killed. No ammo codes occurred toward the end of the scenario as ammunition was depleted. All the last three targets show examples of no ammo codes (see Table 12).

Finally, a separate code was created to indicate whether or not each target was killed. All of the gray shaded entries in Table 12 indicate 'no kills'. This occurred when a target was not hit enough times to qualify as a 'kill'. All other targets were coded as 'kills.'

Summaries of CFF codes. A string of codes (illustrated in Table 12) depicted how each Soldier performed and reacted to each target. It was necessary to categorize these codes in order to reveal patterns and consistencies in the data for each target and across targets. The first level of categorization was to divide the data by Soldiers who killed a target and those who did not. A second level of categorization was developed within the kill and no kill categories as presented in Table 13.

There was consistency across the kill and no kill code categories, except for codes involving "no fires" and "no ammunition." These codes only occurred with no kills, as no fires and no ammunition automatically resulted in a failure to kill. Within most categories, many code combinations occurred. The number and percentage of Soldiers whose shooting pattern occurred within each category were tabulated. These tabulations were done for each company and then combined to provide an overall picture of shooting patterns. See Appendix E for detailed results for each target, as well as how the shooting patterns varied as a function of marksmanship category.

Table 13
CFF Coding Categories for Kills and No Kills

Kill Categories	No Kill Categories
X hits only	Misses only
X hits with misses	Less than X hits with misses
X hits with malfunctions	All misses with malfunction
Hit miss malfunction combinations (previous category included only hits with malfunction; combination category included misses with the required number of hits)	Hit miss malfunction combinations (previous category included only misses with malfunction; the combination category included less than the required number of hits with misses)
X hits with magazine change	All misses with magazine change
Magazine change combinations (previous category included only hits with magazine change; the combination category included misses and/or malfunctions)	Magazine change combinations (previous category included only misses with magazine change; the combination category included less than the required number of hits with misses and/or malfunctions)
Data missing – any code with missing data	No fires only and no fire combinations (any code involving a no fire was included in this category, including magazine changes and malfunctions)
	No ammunition codes (any code with no ammunition was included)
	Data missing – any code with missing data

Note. "X hits" refers to the required number of hits to kill the target.

Soldier questionnaires and interviews, and company commander input. Soldier responses to the questionnaire were tabulated by company, and summarized by POI, AQ-CFF sequence, and all companies. Complete descriptive statistics are in Appendix C, and inferential statistics were conducted as needed. A content analysis was conducted on the interview data with results categorized by the CFF marksmanship categories. The company commanders' input on the background and experience of their cadre was summarized and examined for potential relationships to the companies' marksmanship performance.

Results

All results pertain to the CFF scenario as illustrated in Figure 1 and Table 7, and not to potential variations of it. Soldier performance was found to be very sensitive to CFF parameters, such as target exposure times, which targets bob, the number of hits required for a kill, and the amount of ammunition.

AQ and CFF Results

For all Soldiers, the mean AQ score on first attempt at record fire was 26.66 (SD = 6.7, *n* = 1976). The percentages of Soldiers in each marksmanship category were: 7% Expert, 31% Sharpshooter, 37% Marksman, and 25% Unqualified. For CFF, the mean number of hits was 18.05 (SD = 4.47, *n* = 1820) and the mean points was 45.09 (SD = 13.30, *n* = 1820). The AQ and CFF scores for each of the ten companies are in Table 14. Appendix F presents additional descriptive statistics on these scores as well as the practice fire scores for each course of fire. The results for AQ and CFF for the DSs and the DS candidates are in Table 15.

Table 14
Company Scores on AQ and CFF

Course of Fire	**Current POI**				
	AQ then CFF			CFF then AQ	
	Company				
	M4 w/ M68	M4 w/BUIS	M16A4 w/ IS	M4 w/ M68	M16A4 w/IS
AQ Record					
N	180	177	226	175	202
Mean (SD)	27.84 (6.01)	25.70 (6.11)	25.34 (6.74)	30.91 (5.19)	22.95 (5.85)
% EX/SS/MM/UQ	8/36/37/20	4/23/44/30	2/29/39/30	18/50/25/7	1/11/46/43
CFF Record					
N	165	165	151	174	201
Mean (SD) Points	48.59 (12.28)	42.56 (13.71)	44.62 (12.83)	51.90 (10.46)	40.64 (10.89)
Mean (SD) Hits	19.25 (4.01)	17.16 (4.76)	17.80 (4.32)	20.32 (3.38)	16.64 (3.70)
	Legacy POI				
	AQ then CFF			CFF then AQ	
	Company				
	M4 w/ M68	M4 w/BUIS	M16A4 w/ IS	M4 w/ M68	M16A4 w/IS
AQ Record					
N	190	212	235	152	227
Mean (SD)	28.44 (5.23)	26.42 (5.77)	28.10 (5.79)	31.19 (5.49)	22 (7.69)
% EX/SS/MM/UQ	6/43/37/14	5/25/46/24	9/35/39/17	21/49/23/7	2/15/36/47
CFF Record					
N	184	190	230	153	207
Mean (SD) Points	46.53 (10.79)	43.85 (12.14)	46.61 (12.62)	54.84 (11.81)	34.25 (13.33)
Mean (SD) Hits	18.62 (3.54)	17.86 (4.01)	18.64 (4.19)	21.10 (3.76)	14.15 (4.74)

Note. EX= Expert; SS = Sharpshooter, MM = Marksman, UQ = Unqualified.

Table 15
DS and DS Candidate Scores on AQ and CFF

Course of Fire	DS	DS Candidates
AQ Record		
N	28	89
Mean (SD)	29.39 (5.92)	23.17 (6.08)
% EX/SS/MM/UQ	7 / 50 / 32 / 11	1 / 17 / 42 / 40
CFF Record Score		
N	29	86
Mean (SD) Points	49.76 (12.93)	31.53 (12.98)
Mean (SD) Hits	19.59 (4.23)	13.36 (4.64)

CFF Marksmanship Categories

Recommended CFF cut-points. The percentages of Soldiers in the four AQ marksmanship categories varied considerably across the ten companies (see Table 14). For example the percentage of Experts on the first attempt ranged from 1% to 21%; the percentage of "unqualified" ranged from 7% to 47%. As stated previously, the AQ results (% of Soldiers in each marksmanship category) for each company was applied to the distribution of CFF points and hits for that company. These cut-points are in Table 16. The cut-points resulting from the entire sample of Soldiers was used to determine the recommended cut-points. Lastly, the same procedure was applied to both the DS and DS candidate data to determine if the recommended cut-points replicated for these two samples of noncommissioned officers.

Table 16
Recommended CFF Marksmanship Category Cut-Points

CFF Scores	Marksmanship Category	Cut-points (minimum score for each category		
		Companies	All Soldiers [Recommendation]	DS / DS candidates
CFF Hits	Expert	25, 25, 25 24, 24, 24, 24, 24, 24, 23	24	25 / 34
	Sharpshooter	21, 21, 21, 21, 21, 21 20, 20, 19	21	20 / 18
	Marksman	17, 17, 17, 16, 16, 16 15, 15, 15	16	16 / 13
CFF Points	Expert	64, 64, 64, 63, 63, 63, 63, 63, 63, 62	63	64 / 62
	Sharpshooter	54, 53, 53, 53, 53 52, 51, 50, 48, 48, 47	51	50 / 45
	Marksman	41, 40, 38, 37, 37, 36, 36, 35, 35, 34	37	34 / 28

Despite the variation in AQ scores for the ten companies, the company cut-points for CFF were quite similar, particularly for CFF hits. Within each marksmanship category, the spread of potential cut-points for CFF hits for the ten companies was only 3 hits. Regardless of the original percentage of Soldiers who fell in each category, the cut-point procedure yielded consistent results. Except for Experts, the spread for cut-points was greater with the CFF point score. This difference probably occurred because the range of the CFF points was 0 to 71, whereas the range of CFF hits was from 0 to 26.

The DS results were consistent with the company results. But the DS candidate results were not consistent for the Marksmanship and Sharpshooter categories, falling below the spread of cut-points that occurred for the companies. The primary reason for this discrepancy was that the CFF scores for the DS candidates were lower than those from the other samples. Consequently, when the AQ percentage template was applied to CFF data, the corresponding CFF cut-points were also lower.

Table 17 shows the percentage of all Soldiers in each marksmanship category for AQ and CFF. Because of the unique distribution of CFF hits and points, it was not possible to precisely match the percentages on AQ. The closest match was Unqualified with 25% for each course of fire score. Although a single hit may not appear to have a substantial impact, it did. With the limited scale for CFF hits (0 to 26), a shift in a cut-point by one hit corresponded to about 7% of the Soldiers moving to a different category. Similarly, raising the cut-point for Expert from 24 to 25 for CFF hits resulted in reducing the percentage of Experts by 50 percent. If the cut-point for Sharpshooter was lowered by one, the percentage of Sharpshooters increased by 5% for CFF points and by 8% for CFF hits. The figures in Appendix G show the distributions of AQ scores, CFF hits, and CFF points, and can be used to visually estimate the impact of changing cut-points. Figure G-3 also shows how the frequency distribution of points is "irregular" due to the 3 points assigned to a kill.

Table 17
Percentage Soldiers in the Recommended Marksmanship Categories

Course of Fire	EX	SS	MM	UQ
AQ	6.9%	30.6%	37.5%	24.8%
CFF Points	9.5%	26.3%	39.2%	24.9%
CFF Hits	9.5%	23.4%	41.6%	25.4%

Note. EX= Expert; SS = Sharpshooter, MM = Marksman, UQ = Unqualified.

The CFF standards, based on points and hits, were also examined in terms of the Army's TPU system (DA, 2003), where "T" means trained, "P" means needs practice, and "U" means not trained/serious training deficiency. The recommendation was that "T" correspond to Experts, "P" correspond to Sharpshooter and Marksman, and "U" correspond to Unqualified. Lastly, "Go/NoGo" standards were also recommended, with "NoGo" corresponding to Unqualified (15 points and below), and "Go" to achieving at least the Marksman category (16 points and above).

One way of comparing the recommended cut-points to previous record fire standards is to compute the cut-points as a percentage of total hits and score (see Table 5 for prior record fire course computations). For CFF hits, the corresponding percentages were 92% for Expert, 81% for Sharpshooter, and 62% for Marksman. Each of these percentages is higher than the standards established for prior record fire courses. For the CFF points, the corresponding percentages were 89% for Expert, 72% for Sharpshooter, and 52% for Marksman. The percentages for CFF points were more consistent with prior standards in record fire courses shown in Table 5.

The correlation between CFF hits and points on record fire was .99 (see Table F-4) due to their mathematical dependency (see Table 7). All other analyses were computed using hits, as hits were the only data point available to all training companies on all range printouts. Another disadvantage to using points, even if available, is that it is difficult to interpret and the distribution is quite irregular as kills produced multiple spikes in the distribution (Figure G-3).

In addition, data on CFF kills are in Appendix G. The range of possible kills was from 0 to 15, which further restricted the range of possible scores, making it a less sensitive measure of marksmanship performance than hits. It was not possible to "match" the AQ percentages using kills as well as accomplished with the hit metric (see Table G-1), as one kill typically corresponded to at least 10% of the Soldiers (see Table G-2) when the extremes of the distribution were not considered.

CFF Shooting Patterns

This section presents the shooting patterns that emerged from the CFF lane observation data. Presented first are profiles of a high scoring company and a typical scoring company. Next are CFF shooting patterns for the CFF marksmanship categories. Based on historical records, these shooting pattern data appear to be unique in that they provide decision-makers and others an understanding of how Soldiers in different marksmanship categories perform, and can be used in addition to total score to justify qualification standards. They also provide information to trainers on the relative strengths and weaknesses of Soldiers in these categories. These shooting patterns reflect the dynamics of the CFF course of fire; how the scenario impacts Soldiers' reactions, the consequences of Soldiers' decisions on their performance, and the importance of the ability to integrate marksmanship skills. Lastly, interview data from Soldiers after they fired CFF are presented.

Company profiles on CFF. Figures 4 and 5 show the profiles for two companies based on the lane observation sheets. For each target the profiles show the percentage of Soldiers who killed the target, had misses, had a malfunction, had a magazine change, did not fire (no fire), and were out of ammunition. Figure 4 shows a high company with a CFF hit mean of approximately 21. Figure 5 shows a typical company with CFF hit mean of approximately 18.

The top graph in each figure shows kills, malfunctions, and magazine changes. The bottom graph in each figure repeats the kills for comparison purposes, and shows misses, no fires and no ammunition. The vertical bars at on the X axis separate targets in the kneeling, barricade, and prone firing tables. The target labels on the X axis indicate the distance in meters to the target and the number of hits required to kill the target.

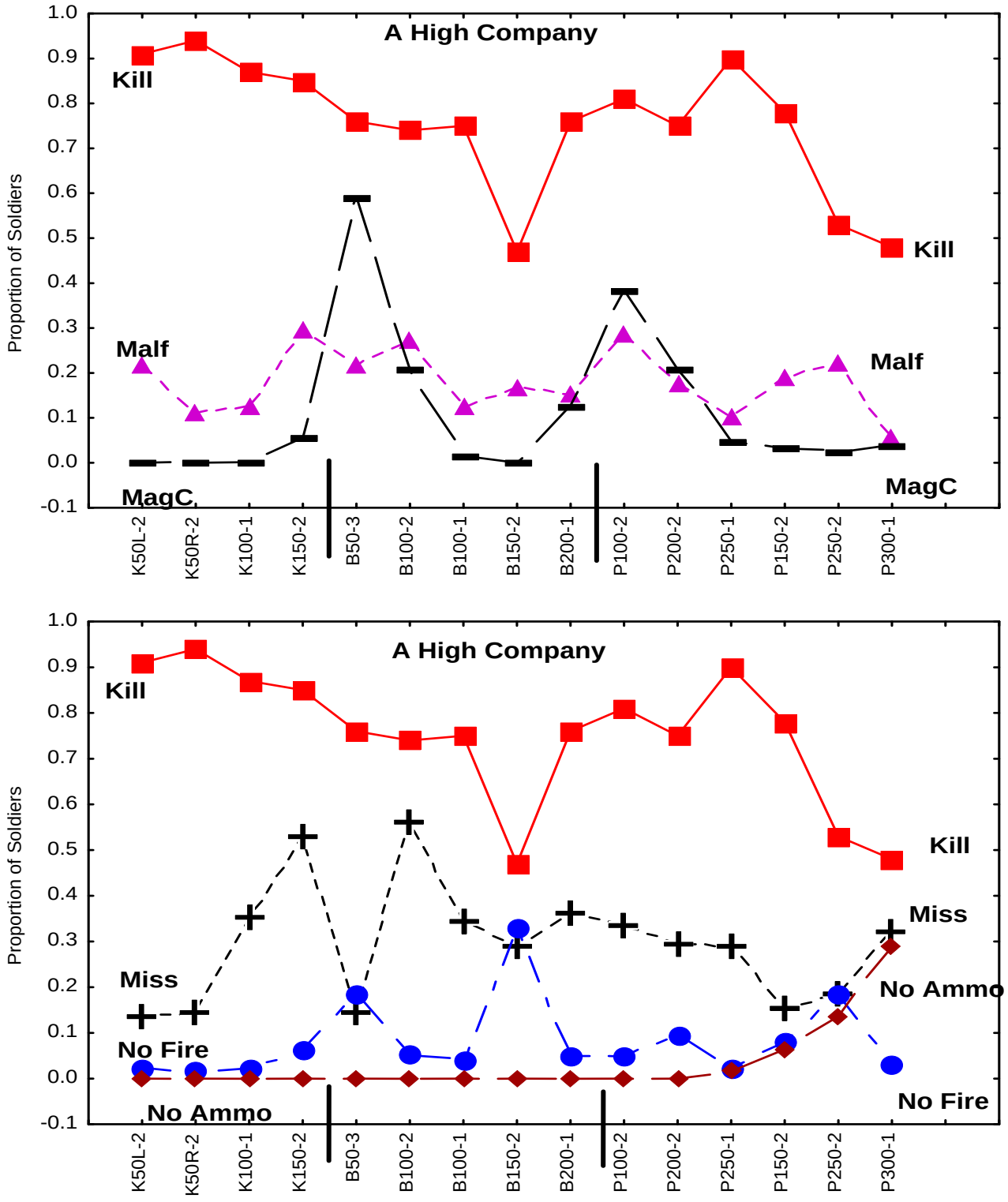

Figure 4. CFF shooting profile for a high scoring company. [MagC refers to magazine change and Malf refers to the induced malfunction created by the dummy rounds.]

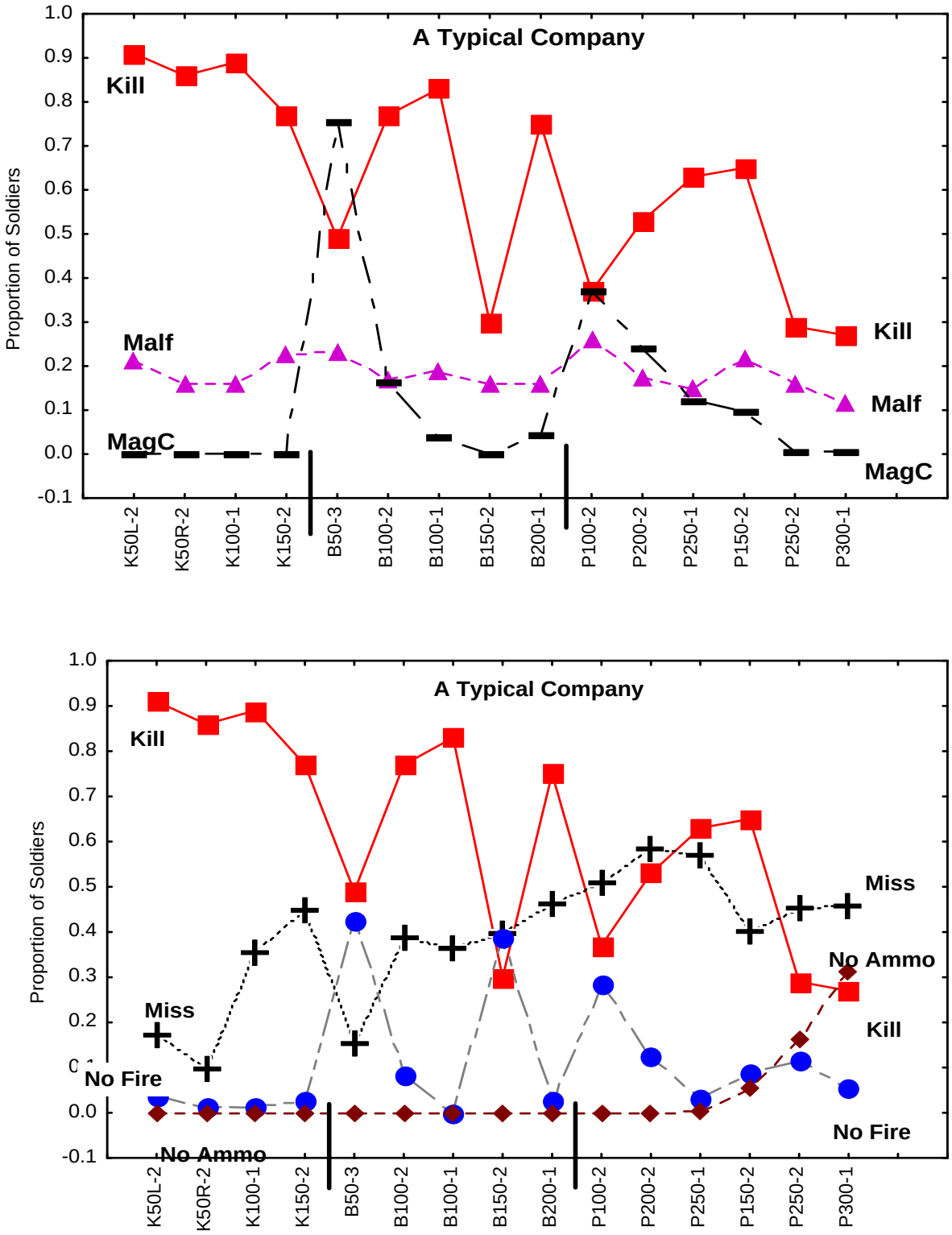

Figure 5. CFF shooting profile for a typical scoring company. [MagC refers to magazine change and Malf refers to the induced malfunction created by the dummy rounds.]

With the high company (Figure 4), the proportion of Soldiers who killed each target (achieved the required number of hits), stayed relatively high except for a "dip" on the 150 meter firing table 2 barricade target, and then dropped with the last two targets. As shown in the top portion of Figure 4, malfunctions occurred throughout the scenario, in accordance with the "randomization" procedure that was used to load and distribute the dummy rounds. The two induced magazine changes tended to occur with the 50-meter target in firing table 2 (barricade, required 3 hits to kill), and with the 100-meter target in firing table 3 (prone, required 2 hits to kill). Of interest is that the probability of kill did not decline when the induced magazine changes occurred.

The bottom portion of Figure 4 shows that no fires were primarily associated with targets in firing table 2: the 150-meter target and to a lesser degree the 50-meter target. As a no fire automatically means a "no kill," it is apparent that the no fires contributed to the dip in probability of kill for the 150-meter target. The reasons for no fires with this target were attributed to a combination of three factors: short exposure time for this target, the requirement for two kills, and shooting at other targets in this phase of the CFF scenario. The no fires most likely meant that Soldiers did not see this target when it came up again, saw it but did not have time to engage it, or that it dropped before a Soldier saw it.

Misses were relatively low for each target, although there was one exception each in firing tables 1 and 2. However, cumulatively misses had an impact on ammunition and kills, as the proportion of Soldiers with no ammunition increased with the last two targets and the probability of kill decreased.

In summary with the high company, no fires impacted the likelihood of killing specific targets, and misses had a cumulative effect on kills which eventually led to unavailability of ammunition. Malfunctions, which occurred throughout, had a general effect on kills, because a failure to kill often occurred in combination with a malfunction, misses, and less than the required number of hits. Magazine changes did not impact kills.

With the typical company (Figure 5), the likelihood of killing a target differed from the high company with regard to two targets. There were two additional targets where the probability of kill dropped – firing table 2, 50-meter target and firing table 3, 100-meter target. The graphs indicate that these targets were also where magazine changes occurred. So with a typical company, magazine changes negatively impacted marksmanship performance. In addition, no fires also occurred with these targets, and were high for the 50-meter target in firing table 2. The proportion of Soldiers with misses increased in firing table 1 and showed a continued upward trend through the remainder of the scenario. The low probability of kill on the last targets, which was lower than that with the high company, was associated with misses as well as Soldiers having no ammunition available. As expected, the occurrence of malfunctions throughout the scenario was similar to the high company.

Compared to the high company, the profile for the typical company showed a general degradation of performance in all the skills examined. The increased number of misses reflected less marksmanship skill. The inability to change magazines and still successfully hit targets reflected poor integration of marksmanship skills.

Both profiles show the cumulative effects of inadequate marksmanship skills and how CFF differs from AQ. With CFF, performance is not a function of target distance (see also Figure G-3) and firing position as is the case with AQ. Even Soldiers who achieve the maximum CFF score will not have necessarily expended the same number of rounds, whereas in AQ the number of rounds would be identical. With CFF, Soldiers engage target arrays of varying degrees of complexity. Targets are not of equal weight, requiring one, two, or three hits for a "kill." Target engagements depend on Soldier decisions and skill. Soldiers must react to multiple conditions within each table. With more rounds than targets, what Soldiers experience with one target in an array influences reactions to the other targets in the array. For example, Soldiers can decide to fire repeatedly to kill a target, as compared to AQ where they are allowed only one round per target. They may need to react to an induced malfunction or change a magazine, which impacts the targets they elect to engage next. They can be exposed to 4 to 7 targets, when hits occur. The Soldier's marksmanship skill has a cumulative effect on the outcome. Firing table 1 outcomes influence firing table 2 outcomes, which in turn influence firing table 3 outcomes.

Clearly, the ability to hit a target is a necessary, but not a sufficient condition, to perform well in CFF. Basic skills must be integrated effectively with other skills under more complex conditions.

The lane observation sheets also provided information on the Soldier's sequence of fire. In general, Soldiers fired from the nearest to the most distant target within each array. With the multiple-hit targets, those that bobbed, Soldiers tended to switch to another target after each hit. They did not stay on the target to see whether it bobbed again. This sequence of fire pattern occurred regardless of the marksmanship category, although there were some slight variations for some targets.

CFF qualification category profiles. The lane observation data showed differences among the marksmanship categories. Thus it was possible to determine whether Soldiers in the different categories were alike or similar on the performance dimensions. An overall picture of skill is presented in Figure 6 which shows the probability of kill for each target (i.e., proportion of Soldiers who killed each target) as a function of marksmanship category.

As illustrated in Figure 6, the probability of kill for each target was highest for Experts and lowest for Unqualified. In addition, the "dip" in probability of kill with the 150-meter target in firing table 2 occurred for every category. Of interest is that in the first firing table, Soldiers classified as Unqualified were already performing at a lower level than Soldiers in the other three categories. However at the end, only Experts remained relatively high. Sharpshooter, Marksman and Unqualified performance tended to merge to a relatively low level. Even though the order of the groups stayed the same throughout, there was a shift in the relative magnitude of these differences from the start to the end of the CFF course of fire.

The lane observation data also highlighted differences in the CFF marksmanship categories in terms of malfunctions, magazine changes, and available ammunition. For each dimension examined, there was a systematic degradation in performance as a function of marksmanship category (see Tables 18 through 20).

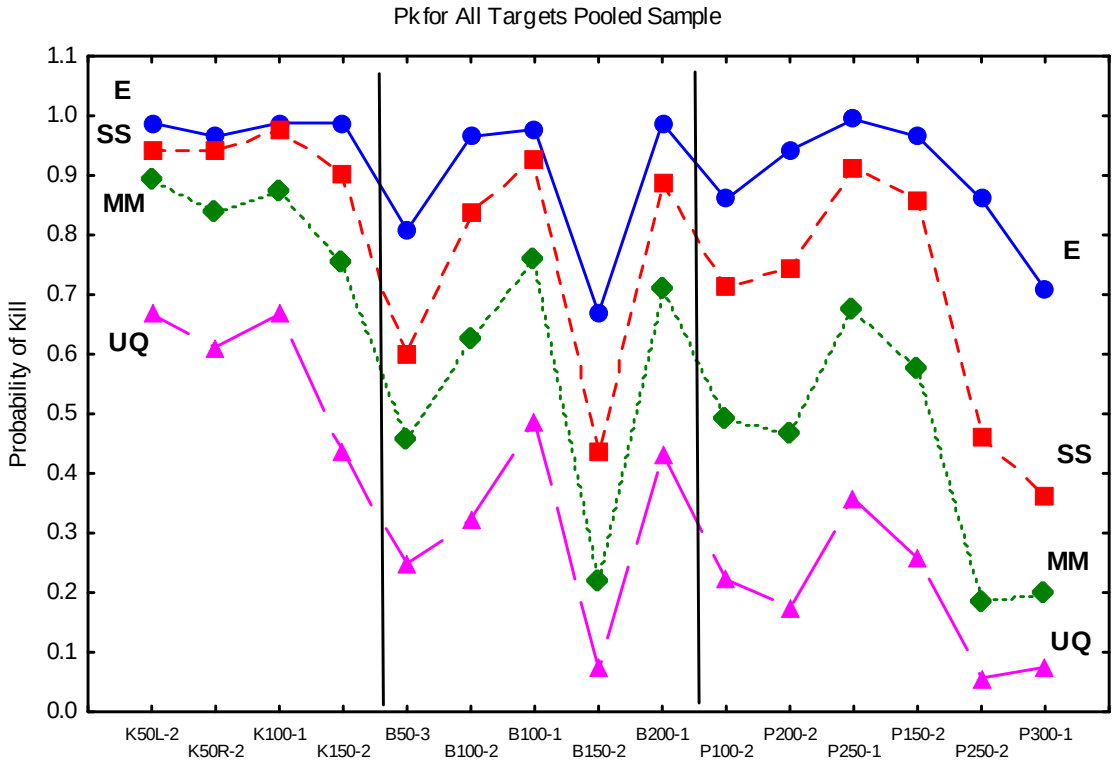

Figure 6. Probability of kill on CFF as a function of CFF marksmanship category.

The percentage of Soldiers achieving a kill when they had a malfunction or a magazine change is in Table 18. For malfunctions, this percentage was the ratio of the number of Soldiers who achieved a kill (had the required number of hits with or without misses) when a malfunction occurred to the total number of Soldiers who had a malfunction, regardless of whether the target was killed. This percentage was determined for each of the 15 targets. A similar calculation was done for magazine changes, but only for the 50-meter target in firing table 2 and the 100-meter target in firing table 3, as magazine changes were most likely with these two targets. Performance systematically declined as a function of CFF marksmanship category.

Table 18
Percentage of Soldiers Achieving a Kill with Malfunctions and Magazine Changes

CFF Marksmanship Category	% Soldiers With a Kill		
	Malfunctions (Mean – All targets)	Magazine Change (50m target, Firing Table 2 barricade)	Magazine Change (100m target, Firing Table 3 prone)
EX	89%	98%	89%
SS	81%	88%	81%
MM	60%	76%	53%
UQ	41%	58%	36%

Table 19 shows results on two other factors related to killing a target: ability to kill a target with no misses (called shooting skill) and ammunition expenditure. For shooting skill, only the first three targets were examined, as performance on these targets was not confounded with magazine changes and unavailability of ammunition. Ammunition expenditure was examined for only the last target which Soldiers typically engaged when they had ammunition (the 300-meter target). The percentage of Soldiers who had ammunition available to engage that target was determined. Again, the results showed a systematic degradation in performance as a direct function of CFF marksmanship category. For shooting skill, performance was lowest for those in the Unqualified group. With regard to ammunition, about half the Soldiers in the Marksman and Unqualified groups had no ammunition for the last target. On the other hand, most Experts (89%) had ammunition for the last target, reflecting their ability to hit targets with few misses throughout the scenario.

Table 19
Percentage of Soldiers Achieving Kills With no Misses and With Misses, and Percentage of Soldiers With no Ammunition to Engage the Last Target

CFF Marksmanship Category	% Soldiers with a Kill [a]		% Soldiers with Ammunition for Last Target
	Hits only	Hits with Misses	
EX	69%	12%	89%
SS	65%	14%	68%
MM	64%	17%	53%
UQ	52%	23%	49%

[a] Means for first three targets (two 50 meter and the 100 meter targets in firing fable 1)

The last factor examined was no fires. A no fire always resulted in a failure to kill a target. No fires were typically associated with multiple-bob targets, short exposure times, malfunctions, and/or magazine changes. The two targets where the most no fires occurred were examined in terms of shooting skill.

For the 50-meter target in firing table 2, where 3 hits were required for a kill, a distinction was made between those Soldiers who had no fires with 2 hits and those who had no fires with less than 2 hits. Both groups included no fire combinations (e.g., hits with miss(es), malfunction, magazine change). The group with 2 hits performed better than the other group due to the higher number of hits, despite the fact that neither group killed the target. A similar distinction was made for the 150-meter target in firing table 2, which required 2 hits for a kill. In this case, the distinction between the groups was no fires with 1 hit and no fire combinations with no hits including two no fires. Results are in Table 20; all no fire combinations are listed in Appendix E. For both targets, performance was a direct function of marksmanship category with Experts exhibiting the most skill and those who did not qualify exhibiting the least skill. For the 150-meter target a substantial percentage of the no fire shooting patterns was simply “2 no fires,” indicating that Soldiers never engaged this target and that their performance did not involve dummy rounds or magazine changes.

Table 20
Percentage of Soldiers With No Kills due to Different No Fire Shooting Patterns

Target in firing table 2	No Fire Shooting Patterns	% Soldiers by CFF Marksmanship Category			
		EX	SS	MM	UQ
50 meter	2 hits with no fire combinations	96%	74%	63%	43%
	<2 hits with no fire combinations	4%	26%	37%	57%
150 meter	1 hit with no fire combinations	76%	59%	58%	28%
	No hits with no fire combinations [a]	24%	41%	42%	72%

[a] Percentages for just "2 no fires" were: 14% Expert, 20% Sharpshooter, 25% Marksman, and 39% Unqualified.

Soldier Reactions to CFF

Soldier interviews were conducted immediately after their firing order during the last (second) iteration of CFF. The intent was gain insights regarding how Soldiers who represented different levels of proficiency reacted to the course of fire. Since standards of performance were not established until after the data were analyzed, it was not possible to randomly sample from each of the four marksmanship categories. Each interview drew upon the Soldier's personal lane observation sheet, as these records were available immediately after the completion of each firing order. Thus, specific questions focused on the unique shooting pattern shown on each sheet. However, if Soldiers did "well" (a score of 22 and above), a typical question asked them to explain that performance; what caused them to shoot well. Another typical question focused on what Soldiers learned from the practice fire (first) iteration of CFF. If Soldiers ran out of ammunition, they were asked whether they were aware that this might happen. General questions about what was difficult for a Soldier (position, magazine change, dummy round, etc.), the pace of the scenario, etc. were also asked.

Interviews were conducted with a sample of 151 Soldiers. When the CFF qualification record scores were applied to their scores, 16% were Experts, 23% were Sharpshooters, 34% were Marksman, and 27% were Unqualified. Compared to all Soldiers, the sample interviewed had a higher percentage of Experts, a lower percentage of Marksmen, and similar percentages of Sharpshooters and Unqualified Soldiers.

The interview comments were placed into nine categories, as indicated in Table 21. In general, the tenor of the responses changed as a function of marksmanship proficiency. Some comments directly reflected the Soldiers' profiles shown previously in Figure 6 and Table 20. For example, Sharpshooters and Experts did not cite weapon malfunctions nor did they indicate that they fired repeatedly at a target in order to hit it or that they had no fires. Another consistency with the performance data is that the negative comments increased as proficiency decreased. In Table 21, instances where at least 50% of the comments were negative or reflected problems are highlighted in gray. The number of negative comments (grayed cells) increased as marksmanship proficiency declined, with no such instances occurring for Experts, five for Sharpshooters, seven for Marksman, and nine for Unqualified.

Table 21
Summary of Interview Comments

Comment Topic	Number of Comments by Marksmanship Proficiency			
	Unqualified	Marksman	Sharpshooter	Expert
Number of Soldiers	41	51	35	24
Number of Comments	122	140	88	63
Impact of Practice Qualification	9	30	30	19
Scenario SA	(1)	(10)	(11)	(9)
Fundamentals	(3)	(8)	(5)	---
Firing Position	(1)	(4)	(3)	(3)
Pacing	(1)	(4)	(8)	(6)
Other	(3)	(4)	(3)	(1)
All comments but one indicated benefits from PQ				
Scenario	12	26	17	5
Pace	(5)	(10)	(9)	(4)
SA	(6)	(8)	(5)	---
Strategy (near to far)	(1)	(6)	(3)	(1)
Other	---	(2)	---	
Fundamentals	38	26	20	20
General comments	(3)	---	(2)	(3)
Zero	(7)	(2)	(1)	(4)
SPORTS (Dummy Round)	(14)	(11)	(9)	(7)
Magazine change	(8)	(5)	(4)	(2)
Sight picture/alignment	(6)	(6)	(4)	(2)
Other	---	(2)	---	(2)
Firing Position	9	19	10	2
Weapon Malfunction	8	7	1	---
All comments but one indicated negative impact from weapon malfunctions				
Ammunition Status	14	12	4	6
Not aware run out of ammo	(6)	(2)	(3)	(1)
Aware run out of ammo	(8)	(7)	---	(2)
Had ammo/aware of status	---	(2)	(1)	(3)
Had ammo/unaware of status	---	(1)	---	---
Shooting	13	5	---	---
Repeated firing at target	(8)	(3)	---	---
No fires	(5)	(2)	---	---
By definition, comments on repeated firing at targets and no firing at targets were negative.				
Personal Comments	8	6	1	4
Training Recommendations	11	9	5	7

Note. Numbers in parentheses are subtopic counts. Cells shaded in gray are areas where at least 50% of the comments were negative or indicated problems.

In general, *practice qualification on CFF* (first iteration) positively impacted Soldiers and how they reacted to CFF during qualification. Positive comments on situation awareness were learning about scanning, becoming aware of the length of target exposure, target location, number of hits required, and target order. Pacing comments were typically that Soldiers learned that they should not rush and to stay calm during qualification. Soldiers indicated that a slower pace also meant better breath control. Positive comments regarding fundamentals referred to the fact that practice qualification helped with reacting to malfunctions, and/or that they learned the importance of focusing on applying fundamentals. Other positive comments were general statements that practice qualification helped or gave them more confidence.

Regarding the *scenario* itself, positive comments on pace were that it was okay, they could handle it. Negative comments were that the scenario pushed them. Positive comments on shooting strategy were that they shot at the closest targets first; negative comments were that they did not use this strategy. Comments on being aware of what happened during the scenario were varied. An interesting problem emerged during interviews with some Soldiers who did not qualify. They were not aware of both two 50-meter targets in the kneeling position. This was because they fired from behind the barricade and did not position themselves so both targets were visible in their sector of fire. They only saw one of the targets. In addition, a common problem commented on by Soldiers in the Marksmanship and Sharpshooter categories was that they saw targets but the targets went down before they were able to engage them.

With regard to *fundamentals*, typical negative comments regarding zero were that Soldiers thought their zero was wrong; positive comments were that they had a good zero. Typical negative comments on sight picture were that they had trouble getting a good sight picture from a particular firing position or had trouble maintaining a consistent sight picture. The majority indicated they handled the malfunction created by the dummy round and the magazine change. Soldiers who did not qualify were most likely to mention problems; they stated they did not react to the dummy round or malfunction fast enough.

For Marksmen and Sharpshooters, most comments were on the kneeling and barricade firing *positions*. Soldiers indicated they needed more practice in these positions. Indicative of this problem was that Soldiers also commented on trying out different barricade positions to adjust to the barricade height (e.g., stand vs. kneel) in order to determine what worked best for them.

The *weapon malfunctions* category refers to Soldiers indicating they had a live-fire malfunction, typically double feeds which were very difficult and time-consuming to clear and accounted for why Soldiers were unable to fire at certain targets.

Regarding *ammunition*, three Soldiers, all Experts, commented that they kept track of how many rounds they fired or tried to conserve ammunition. For the other Soldiers, only Soldiers who did not qualify indicated they were likely to be unaware that they would run out of ammunition. Soldiers ran out of ammunition when they repeatedly fired at targets and missed them, and those interviewed indicated that they were aware of the impact of this type of shooting. When asked why they continued to fire at a target, they typically indicated that they

simply wanted to "get it." Another shooting problem was not firing at targets. With the exception of Soldiers being unaware of both 50-meter targets in the kneeling position, Soldiers interviewed about no fires often indicated they had seen the target but could not engage it in time. It is important to note that the interviews did not focus on the no fires that occurred in the barricade position with the 150-meter target (see Figure 6) because the seriousness of this problem was not known when the interviews were conducted.

Negative *personal comments* by those who did not qualify were that they reacted emotionally to their performance early in the scenario (became flustered, frustrated, or overexcited). This reaction led them to rush their shots, to not control their breathing, and/or to become careless. Their inability to address these initial problems simply compounded the shooting problems in the later phases of the scenario. Such reactions also occurred, but to a much lesser degree, with Marksmen and Sharpshooters. Positive comments varied, to include well trained for CFF, had a good weapon, had a good drill sergeant, and prior shooting experience explained good performance.

Regarding *training recommendations*, about half focused on the fundamentals of shooting. In turn, half the comments were simply general recommendations to stress the basics; the other half dealt with fundamentals of sight picture, malfunction procedures, and breathing. Given the nature of CFF, the recommendation by one Soldier to "keep the same sight picture and be able to do this quickly and instinctively" is particularly relevant. The remaining comments were about equally divided among firing positions, not rushing shots, and learning to transition between targets. Comments on not rushing shots and transitioning between targets were directly relevant to success with the CFF scenario.

In general, Soldiers reacted to the targets presented and did not seem to be motivated by the type of scores they were to receive (e.g., hits vs. points). In fact, the majority were unaware of the scoring systems used, as they were only informed that they were to hit all the targets in each array.

In summary, the interviews indicated that the more proficient Soldiers typically did not indicate they had problems with the fundamentals of shooting. They used the practice qualification scenario to their advantage as a learning opportunity both in terms of technical skill and being aware of the scenario demands, and they were able to effectively employ what they learned during CFF qualification. At the other extreme, those who did not qualify had difficulties with shooting basics, did not learn how to improve basic skills from practice qualification and did not indicate that they used practice qualification to understand the requirements of the CFF scenario. In addition, some reacted emotionally to initial shooting problems, which in turn led to additional shooting problems.

The pattern and content of all the comments reflects one of the general findings regarding differences in individual skill proficiency (Kalyuga, 2009), that after extensive practice, processing can become automatic, thereby freeing attentional capacity for other tasks. The more expert individuals had limited problems with the fundamental skills of shooting, and they did not have to think about these skills as the skills were more automatic. This enabled them to focus on the nature of and challenges presented by the scenario itself and to leverage what they learned

during practice qualification. On the other hand, the less proficient Soldiers had to consciously focus on shooting fundamentals which inhibited good performance on this complex scenario when their fundamental skills were weak.

Placement of CFF in the Marksmanship POI and Replacement for or Supplement to AQ

The CFF shooting pattern results just described clearly showed that CFF differs from AQ. Additional skills are required. The most obvious additional requirements are an ability to react to a simulated malfunction, to rapidly change magazines, and to fire from a barricade position. Other skills include scanning to detect multiple targets in a sector of fire and detecting targets that may reappear, decision-making on the sequence of engaging targets, decision-making regarding expenditure of ammunition, and ability to maintain a good sight picture as the scenario changes and additional demands are made on the firer (e.g., change magazine behind concealment, and re-establish firing position). The marksmanship effects (negative and positive) cumulate for the individual firer and Soldiers must integrate many skills under dynamically changing and more demanding conditions. Also the ability to hit targets, which is assessed in AQ, is a necessary but not sufficient condition for success. Consequently, the performance data indicated that CFF should follow AQ in the marksmanship POI.

Other data also impacted where CFF should be in the POI and whether it should replace or supplement AQ. These results are in the next sections.

Questionnaire data comparing AQ to CFF. All Soldiers completed a questionnaire after completion of ARM (see Appendix C). Some questions directly compared AQ and CFF, while others dealt with more general marksmanship issues. The former category of questions was examined with regards to sequence of fire effects, as they related to the recommendation regarding CFF placement in the marksmanship POI.

Common skills. Soldiers were asked to compare the difficulty of using five specific skills during both AQ and CFF. These skills were common skills, required to a greater or lesser degree in both scenarios. The response options were: the skills were more difficult to use in AQ, equally difficult to use in both AQ and CFF, or more difficult to use in CFF.

The common skills and patterns of Soldier responses are shown in Table 22. Regardless of the skill, the most frequent response (at least 50%) was that the skill was equally difficult in both courses of fire. Sequence of fire effects (i.e., which course, AQ or CFF, was executed first in BRM) were found for the first four skills listed: hitting 250- and 300-meter targets, hitting 50- and 100-meter targets, hitting multiple targets, and detecting targets. A higher percentage of Soldiers found it more difficult to perform the first three skills in the first scenario encountered (whether AQ or CFF) than in the second scenario (whether AQ or CFF). The sequence effect for the fourth skill was isolated to AQ performance, with a higher percentage of Soldiers indicating that detecting targets in the shooting lane was more difficult in AQ when AQ was the first scenario rather than the second. There were no sequence effects on firing from a kneeling position.

Table 22
Percentage of Soldiers Indicating Relative Difficulty of Executing Skills Common to AQ and CFF

Skill	Responses	Sequence of Fire		Chi-square Tests
		AQ-CFF	CFF-AQ	
Hitting 250 and 300 meter targets	AQ Harder Same CFF Harder	31% (324) 51% (536) 19% (202)	20% (139) 55% (381) 26% (179)	χ^2 (2, N = 1761) = 27.87*
Hitting 50 and 100 meter targets	AQ Harder Same CFF Harder	22% (234) 67% (711) 11% (112)	13% (92) 73% (511) 14% (96)	χ^2 (2, N = 1756) = 23.82*
Hitting multiple targets exposed at the same time	AQ Harder Same CFF Harder	34% (364) 49% (522) 17% (177)	12% (84) 68% (474) 20% (140)	χ^2 (2, N = 1762) = 111.41*
Detecting targets in the shooting lane	AQ Harder Same CFF Harder	25% (268) 58% (609) 17% (183)	17% (121) 66% (463) 16% (114)	χ^2 (2, N = 1758) = 17.67*
Firing from a kneeling position	AQ Harder Same CFF Harder	26% (268) 59% (612) 15% (160)	29% (204) 55% (386) 16% (108)	χ^2 (2, N = 1738) = 2.75

Note: Number of respondents in parentheses. Percentages based on total number of Soldiers within a sequence of fire.
* $p < .05$

CFF-specific skills. The Soldiers asked about the difficulty of five skills specific to CFF. They indicated whether they found it difficult (or not) to use these skills in CFF. The responses options were Yes/No.

The skills and patterns of Soldier responses are displayed in Table 23. Sequence of fire effects were found for the first three skills listed: changing magazines, correcting malfunctions, and remembering to scan for bobbing targets. A higher percentage of Soldiers found it more difficult to perform these skills when CFF was the first scenario than the second. The most striking pattern was found in being able to quickly change magazines. The percentage of Soldiers who found it difficult to change magazines quickly was more than eight-fold higher in the CFF-AQ sequence than the AQ-CFF sequence (86% vs. 10%). In summary, a higher percentage of Soldiers found it more difficult to perform CFF-specific skills when CFF was the first course of fire encountered rather than the second. It is noted that the Legacy POI did not stress these skills until ARM.

Table 23
Percentage of Soldiers Indicating Difficulty of CFF-Specific Skills

Skill	Difficult to Use in CFF Responses	Sequence of Fire		Chi-square Tests
		AQ-CFF	CFF-AQ	
Changing magazines quickly	Yes No	10% (107) 90% (957)	86% (600) 14% (98)	χ^2 (1, N = 1762) = 6.51*
Correcting a malfunction in reaction to the dummy rounds	Yes No	13% (134) 87% (930)	20% (143) 80% (555)	χ^2 (1, N = 1762) = 19.82*
Remembering to scan for targets that could bob up again after you had hit them twice.	Yes No	13% (143) 87% (921)	23% (162) 77% (536)	χ^2 (1, N = 1762) = 28.10*
Maintaining the same sight picture when changing positions in reaction to a malfunction or after changing magazines.	Yes No	27% (285) 73% (779)	30% (210) 70% (488)	χ^2 (1, N = 1762) = 2.27
Having a stable position when firing from a barricade	Yes No	16% (173) 84% (891)	19% (132) 81% (565)	χ^2 (1, N = 1761) = 2.11

Note: Number of respondents in parentheses. Percentages based on total number of Soldiers within a sequence of fire.
* $p < .05$

Scenarios and effects on confidence. Soldiers indicated which scenario gave them more confidence in their marksmanship skills. Soldier responses are in Table 24. Sequence effects were found. A higher percentage of Soldiers indicated they gained confidence from the second scenario completed rather than the first, whether the first scenario was AQ or CFF. However, this effect was much stronger for CFF, with the percentage of Soldiers indicating a confidence gain from CFF as the second scenario more than twice the percentage of Soldiers indicating a confidence gain from CFF as the first scenario (43% vs. 20%).

Table 24
Percentage of Soldiers Indicating Which Scenario Gave Them the Most Confidence

Responses	Sequence of Fire		Chi-square Test
	AQ-CFF	CFF-AQ	
AQ	24%(256)	37% (261)	χ^2 (2, N = 1762) = 106.70*
Same	33% (350)	43% (302)	
CFF	43% (457)	20% (136)	

Note: Number of respondents in parentheses. Percentages based on total number of Soldiers in a sequence of fire.
* $p < .05$

Soldiers were also asked whether firing one scenario before the other increased their confidence that they could do well on either. Response categories included Yes, No Impact, and Made Me Unsure/Uncertain. The pattern of Soldier responses is displayed in Table 25 (see also Figure C-3). There was a sequence effect. Regardless of firing sequence, the most common response (at least 50%) was that firing the first scenario increased confidence in their ability to do well on the second. A higher percentage of Soldiers, however, indicated that firing AQ before CFF instilled more confidence in CFF, relative to the impact of firing CFF on confidence in AQ (65% vs. 53%). In addition, the percentage of Soldiers who were made uncertain by firing CFF first was nearly twice as high as that of Soldiers who fired CFF second (16% vs. 9%).

Table 25
Percentage of Soldiers Indicating First Scenario Increased Confidence in Second Scenario

Responses	Sequence of Fire		Chi-square Test
	AQ-CFF	CFF-AQ	
Yes	65% (689)	53% (372)	χ^2 (2, N = 1762) = 32.37*
No Impact	26% (282)	31% (214)	
Made Me Unsure/Uncertain	9% (92)	16% (113)	

Note: Number of respondents in parentheses. Percentages based on total number of Soldiers in a sequence of fire.
* $p < .05$

Scenario difficulty. Soldiers were also asked which scenario was more difficult. The pattern of Soldier responses is displayed in Table 26. A sequence effect was found for AQ only, as a higher percentage of Soldiers of Soldiers in the AQ-CFF sequence found AQ more difficult than CFF (43% vs. 27%). Of the Soldiers in the CFF-AQ sequence, as many Soldiers found AQ to be more difficult as found CFF more difficult (32% vs. 31%).

Table 26
Percentage of Soldiers Indicating Which Scenario was More Difficult

Responses	Sequence of Fire		Chi-square Test
	AQ-CFF	CFF-AQ	
AQ	43% (455)	32% (220)	χ^2 (2, N = 1762) = 23.75*
Same	30% (316)	37% (261)	
CFF	27% (292)	31% (219)	

Note: Number of respondents in parentheses. Percentages based on total number of Soldiers within a sequence of fire.
* $p < .05$

Questionnaire summary. It was argued at the beginning of this section that AQ and CFF are distinct scenarios. The questionnaire data are consistent with this. When Soldiers were asked about skills common to both AQ and CFF, sequence effects were seen. When the first scenario was AQ, more Soldiers perceived the common skills as difficult in AQ than in CFF. When CFF was first, these differences were not consistent.

However, a different pattern was seen when Soldiers were asked if they found it difficult to use CFF-specific skills. A higher percentage of Soldiers found it difficult to perform those skills when CFF was the first scenario than when CFF was the second scenario. The percentage of Soldiers who gained confidence in their marksmanship skills through firing CFF as the second scenario was nearly twice that of Soldiers who fired CFF as the first scenario. Similarly, the percentage of Soldiers who gained confidence in their ability to do well in both scenarios through firing AQ first was higher than that of Soldiers who fired CFF first. More strikingly, the percentage of Soldiers who were made uncertain of their ability to do well on both scenarios by firing CFF as the first scenario was almost twice that of Soldiers who fired CFF as the second scenario. Taken together, these findings contribute to a strong cumulative case for placing CFF in ARM rather than BRM, and are consistent with the crawl / walk / run philosophy of training.

However, there is one finding that seems inconsistent with the above statement. Sequence of fire impacted global perceptions of scenario difficulty for AQ only. When AQ was fired first, a higher percentage of Soldiers found it more difficult than when AQ was fired second. It should be borne in mind that AQ was a graduation requirement for all Soldiers, while CFF was not, and the AQ requirement may have influenced Soldier perceptions.

Relationship between AQ and CFF scores. Some required skills were common to both AQ and CFF, while other skills were specific to CFF. Given this, it might be expected that the AQ and CFF record fire scores would be moderately related to one another. This is what was found (r (1779) = .46, $p < .05$). Another factor placing an upper limit upon the AQ-CFF correlation was the fact that the correlations between the practice and record fire events for each scenario were themselves far from unity (average $r = .55$, $p < .05$). This result underlines the contention that the AQ and CFF scenarios are not interchangeable. Part-whole correlations and correlations for each company are in Appendix F.

Another way of examining the relationship between AQ and CFF was to determine which marksmanship categories related most strongly to the Soldiers in the two extreme marksmanship categories, that is the Soldiers who did not qualify and Soldiers who qualified as Experts. Specifically we examined the relationship of AQ record and CFF practice to CFF record. In addition, we examined the relationship of AQ practice and CFF record to AQ record.

As shown in Table 27 for the two extreme categories of Unqualified and Expert, there was greater consistency within the scenarios than across scenarios. For example, the top section of the table includes Soldiers who did not qualify on CFF. Of these Soldiers, 67% did not meet the qualification cut-point on CFF practice, while only 43% were Unqualified on AQ. Thus the better category predictor was CFF practice not AQ. A similar pattern existed for those who did not qualify on AQ, with the higher percentage being those who did not meet the qualification cut-point on practice AQ as opposed to CFF (67% vs. 46%). The practical implication of these findings is that in order to identify individuals likely to have problems on AQ or CFF you should focus on the Soldiers who have difficulty in the corresponding practice iteration of each scenario.

A similar result occurred for those who qualified as Expert, but the relationship was not as strong. In other words, the percentage of Soldiers who consistently fell in the Expert category

was lower (21% to 33%). In fact, more of the Experts were Sharpshooters (38% to 52%). It was harder to predict who might qualify as Expert on AQ and CFF.

Table 27
Associations Within the Marksmanship Categories of Unqualified and Expert

Soldiers who did not Qualify on CFF Record							
% Soldiers in CFF Practice Categories				% Soldiers in AQ Record Categories			
UQ	MM	SS	EX	UQ	MM	SS	EX
67%	26%	6%	<1%	43%	42%	14%	1%
Soldiers who Qualified as Expert on CFF Record							
% Soldiers in CFF Practice Categories				% Soldiers in AQ record Categories			
UQ	MM	SS	EX	UQ	MM	SS	EX
7%	28%	39%	26%	7%	20%	52%	21%
Soldiers who did not Qualify on AQ Record							
% Soldiers in CFF Record Categories				% Soldiers in AQ Practice Categories			
UQ	MM	SS	EX	UQ	MM	SS	EX
46%	41%	11%	3%?	67%	27%	6%	0%
Soldiers who Qualified Expert on AQ Record							
% Soldiers in CFF Record Categories				% Soldiers in AQ Practice Categories			
UQ	MM	SS	EX	UQ	MM	SS	EX
4%	32%	38%	26%	7%	19%	41%	33%

POI, sequence of fire and weapon sight comparisons. This section details the effects of the POIs upon AQ scores and CFF hits. The confounding between the weapon and Soldier population is acknowledged but was unavoidable given that BCT and OSUT Soldiers have different weapon systems. This disparity may have impacted the results presented in this section.

As POI interacted with the Sequence of Fire and Weapon Sight variables, it is necessary to discuss them as well. The Weapon Sight variable was made dichotomous; the M4 carbine with M68 as one variation and the M4 with the BUIS and M16A4 with iron sights combined to make the other variation. Several steps were taken to aid in readability. First, statistical information within the text is minimized. The emphasis in the text is upon the overall pattern of results. To this end, statistical tables are included at Appendix H. These tables also include estimates of effect size, as some of the effects, while statistically significant, were not practically significant. Second, a couple of decision rules were used to decide whether an effect was worth analyzing in detail. An effect not only had to be statistically significant, operationally defined as $p < .05$, but

also had to be practically significant, operationally defined as an effect size accounting for more than one percent of variance in one or both of the scenarios and to be robust, operationally defined as exhibiting a similar pattern in both scenarios. Third, only significant interactions are graphed. Significant simple main effects are discussed via means and standard deviations.

AQ scores. There was a robust, statistically and practically significant three-way interaction between POI, Sequence of Fire, and Weapon Sight variables upon AQ scores (see Table H-1). In order to understand the nature of this three-way interaction, a 2 (Sequence of Fire) x 2 (Weapon Sight) analysis of variance (ANOVA) was computed for each of the two levels of the POI variable (see Figure 7 as well as Tables H-3 and H-4). In the Legacy POI condition, the Sequence of Fire variable had an effect, with Soldiers in the AQ-CFF condition performing better, on average, than Soldiers in the CFF-AQ condition. This appeared to be due to the fact that Soldiers who shot in the CFF-AQ condition with iron sights performed poorly, thus dragging down the CFF-AQ average. However, Sequence did not have an effect in the Current POI condition.

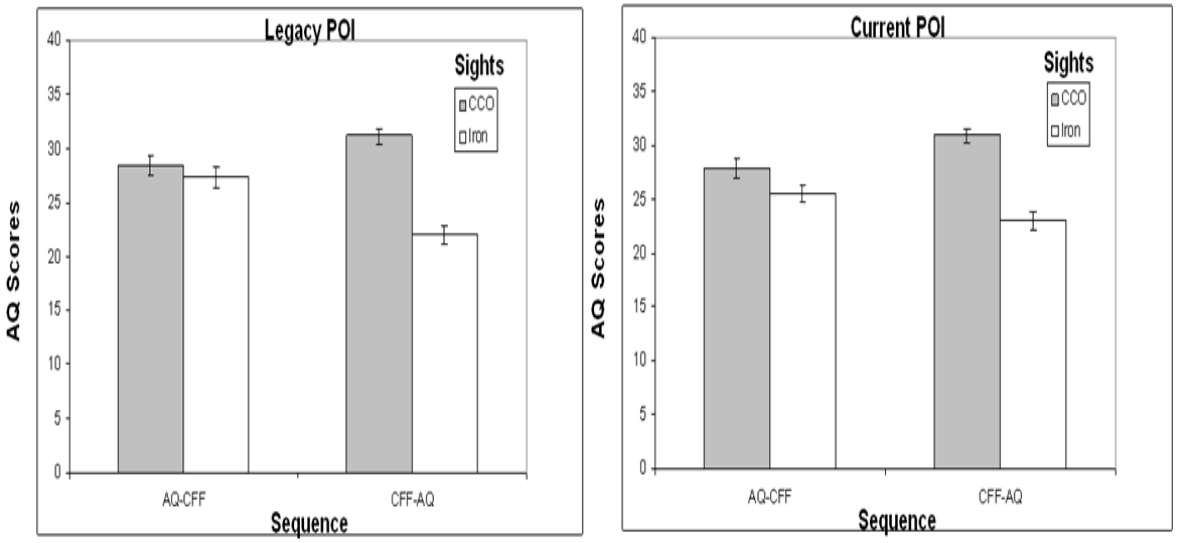

Figure 7. Three-way interaction of POI, sequence of fire, and weapon sight on AQ scores. (Error bars represent a 95% confidence interval.)

There was also a robust, statistically and practically significant Sequence by Weapon Sight interaction as seen in Figure 8. While Soldiers who used CCO sights outperformed Soldiers using iron sights regardless of sequence, the CCO-conferred advantage was largest in the CFF-AQ sequence. Once again, Soldiers who used iron sights in the CFF-AQ sequence performed the most poorly.

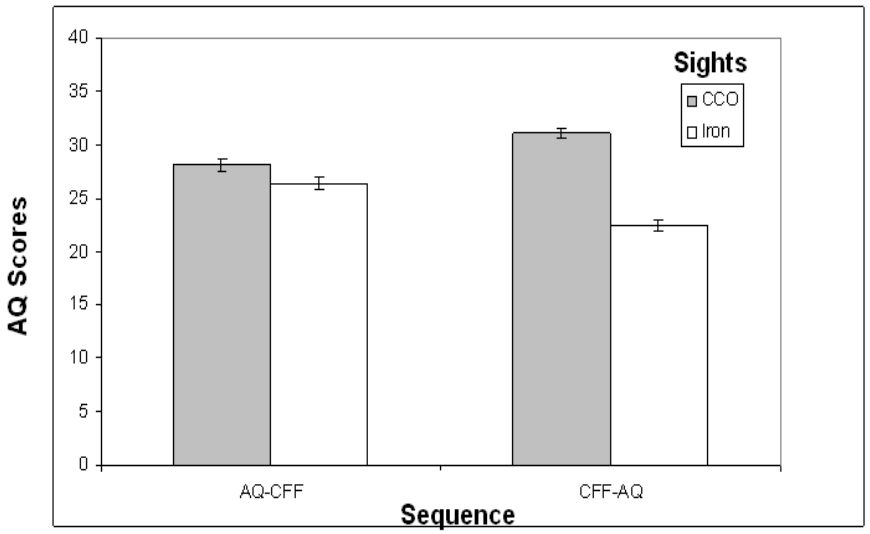

Figure 8. Interaction of sequence of fire and weapon sight on AQ scores. (Error bars represent a 95% confidence interval.)

The POI by Weapon Sight interaction was not robust, nor was it statistically or practically significant. The POI by Sequence interaction was neither robust nor practically significant. A robust, statistically and practically significant effect was found for Weapon Sight, with Soldiers using CCO sights (M = 29.51, SD = 5.67) performing better than Soldiers using iron sights (M = 25.11, SD = 6.71). The Sequence variable main effect was not robust, nor was it statistically or practically significant. The same pattern held for the POI variable.

CFF hits. There was a robust, statistically and practically significant three-way interaction between POI, Sequence of Fire, and Weapon Sight (see Table H-5). A 2 (Sequence of Fire) x 2 (Weapon Sight) ANOVA was computed for each of the two levels of the POI variable (see Figure 9 as well as Tables H-7 and H-8). Sequence had a significant effect upon Soldiers in the Legacy POI condition. Of Soldiers in the Legacy POI condition, those in the AQ-CFF sequence performed better than Soldiers in the CFF-AQ sequence. This appeared to be due to the fact that Soldiers who shot in the CFF-AQ condition with iron sights performed poorly, thus dragging down the CFF-AQ average. However, Sequence did not have an effect in the Current POI condition.

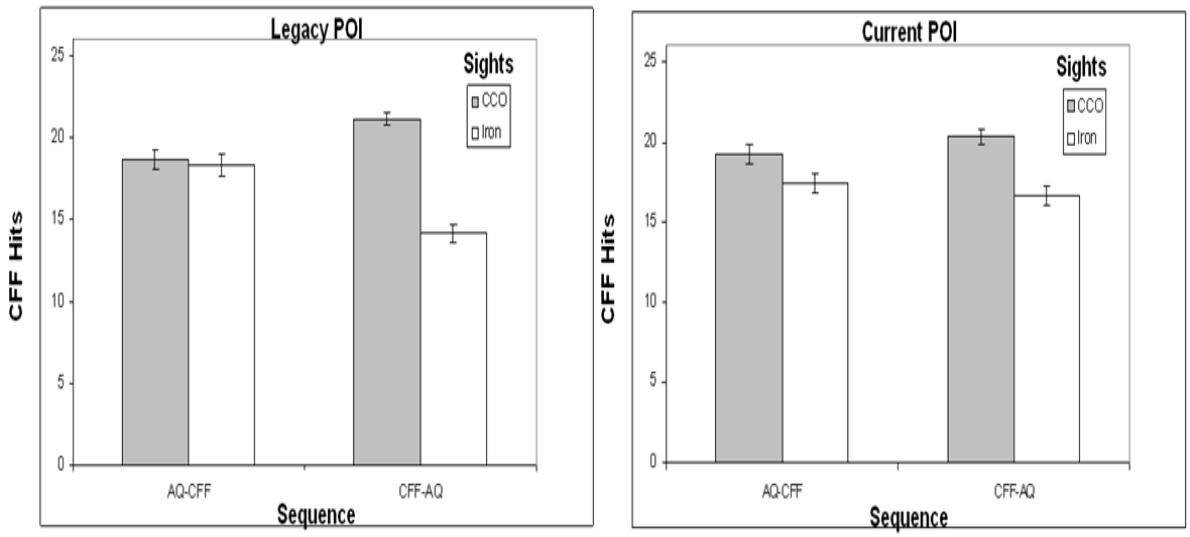

Figure 9. Three-way interaction of POI, sequence of fire, and weapon sight on CFF hits. (Error bars represent a 95% confidence interval.)

There was a robust, statistically and practically significant Sequence by Weapon Sight interaction (see Figure 10). While Soldiers who used CCO sights outperformed Soldiers using iron sights regardless of sequence, the CCO-conferred advantage was largest in the CFF-AQ sequence. Soldiers who used iron sights in the CFF-AQ sequence performed the most poorly.

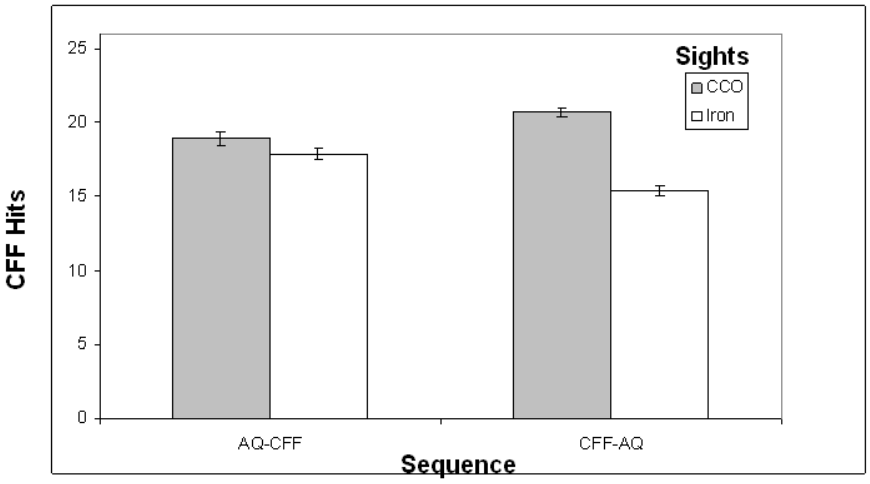

Figure 10. Interaction of sequence of fire and weapon sight on CFF hits. (Error bars represent a 95% confidence interval.)

The POI by Weapon Sight interaction was statistically significant but not robust or practically significant. The POI by Sequence interaction was robust and statistically, but not

practically, significant. There was a robust, statistically and practically significant main effect for Weapon Sight, with Soldiers using CCO sights (M = 19.77, SD = 3.78) performing significantly better than Soldiers using iron sights (M = 17.02, SD = 4.54). The Sequence variable main effect was not robust, nor was it statistically or practically significant. The same pattern held for the POI variable.

BRM POI effect. Interestingly, the POI did have a small but statistically significant effect on initial firing event but not on the second firing event (partial eta-squared estimates less than .02). When AQ was the first course of fire, Soldiers in the Legacy POI (M = 27.65, SD = 5.68) outperformed Soldiers in the Current POI (M =26.22, SD = 6.42), F (1, 1218) = 16.90, p <.001. When CFF was the first course of fire, Soldiers in the Current POI (M =18.35, SD = 4.00) outperformed Soldiers in the Legacy POI (M = 17.10, SD = 5.54), F (1, 733) = 12.26, p < .01. However, the POI did not significantly impact performance on the second firing event, whether Army qualification or CFF.

Discussion of AQ scores and CFF hits. The pattern of results was largely the same for both AQ scores and CFF hits. For both scenarios, there was a three-way interaction of the POI, Sequence, and Weapon Sight factors. While Sequence did not impact performance in the Current POI condition, it did affect performance in the Legacy POI condition. Of Soldiers in the Legacy POI condition, those in the CFF-AQ scenario performed worse than those in the AQ-CFF condition. This resulted from the poor performance of Soldiers with iron sights.

For both scenarios, there was an interaction between Sequence of Fire and Weapon Sight. While Soldiers who used CCO sights outperformed Soldiers using iron sights regardless of sequence, the CCO-conferred advantage was largest in the CFF-AQ sequence. Soldiers who used iron sights in the CFF-AQ sequence performed the most poorly.

For both scenarios, the POI by Weapon Sight effect failed to meet one or more of the decision rule criteria for further analysis, as did the POI by Sequence of Fire effect, the Sequence of Fire effect, and the POI effect. There was a statistically and practically significant main effect for Weapon Sight in both scenarios, with performance on both AQ and CFF higher for Soldiers with CCO sights than iron sights.

The Sequence of Fire effects tend to support placing CFF in ARM rather than BRM. Performance on both CFF and AQ was slightly (albeit not significantly) higher for Soldiers in the AQ-CFF sequence than those in the CFF-AQ sequence. Further, Soldiers who shot with iron sights did significantly poorer in the CFF-AQ sequence, regardless of scenario, than in the AQ-CFF sequence.

Questionnaire Results

This section presents additional results from the Soldier questionnaire. The results on Soldier confidence and questions specific to AQ and CFF were presented previously in the section on where CFF should be in the marksmanship POI. Appendix C contains data on each question by company as well as summaries by Sequence of Fire and POI, where appropriate.

Factors contributing to AQ performance on first attempt. Soldiers were asked whether they qualified on the first attempt at AQ. They were then asked what factors contributed to their success or to their failure to qualify initially. A list of options was presented and Soldiers could check as many reasons as desired.

For those who qualified the first time, six factors were cited by at least 72% of the Soldiers as contributing to their success (see Figure C-1). From high (89%) to low (72%), these factors were: had good training on marksmanship fundamentals, good zero on weapon, was calm / relaxed and able to concentrate, gained confidence from practice qualification, had sufficient practice on marksmanship fundamentals, and DSs motivated me to do well. Of interest is that prior experience with weapons was marked by only 52% of these Soldiers. Considering all factors, the percentage of Marksmen who marked each of these factors was typically lower than the corresponding percentages of Sharpshooters and Experts (see Table C-3).

For those who did not qualify the first time, there was less agreement on the reasons. Three factors were cited by at least 38% of the Soldiers (see Figure C-2). From high (42%) to low (38%) these were being nervous, no or limited prior experience with weapons, and poor zero on weapon.

Marksmanship skills. Many of the questions focused on individual marksmanship skills. Two questions were asked of each skill: whether Soldiers felt they needed more practice and whether the skill was difficult to learn. Typically, more Soldiers felt they needed practice than felt the skill was difficult to learn. Thus even though a skill was not always hard to learn, Soldiers felt they needed more practice. This part of the questionnaire had four sections: firing positions, weapon handling procedures, basic skills, and target engagement.

Firing positions. Overall, more Soldiers indicated that the kneeling position required more practice (59%) as well as being difficult to learn (47%) (see Table C-17). For these questions the Soldiers could check more than one position as needing practice or difficult to learn.

Most Soldiers (84%) indicated that the prone position was the most comfortable, while 68% indicated that kneeling was the least comfortable. For these questions, Soldiers could check only one position.

Weapon handling procedures. Weapon handling procedures were maintenance, function check, preventing accidental discharge, rapidly changing magazines in difficult positions, quickly correcting a malfunction, and proper weapon clearing procedures. The percentages of Soldiers marking these procedures as needed more practice or difficult to learn were not high. Only two were marked by at least 20% of the Soldiers on these two dimensions: rapidly changing magazines and correcting malfunctions (see Table C-23). The other four procedures were marked by 10% or fewer Soldiers as needing more practice or as difficult to learn.

Basic skills. Six basic skills were covered: adjusting iron sights to zero weapon with no assistance, adjusting the M68 (CCO) to zero weapon with no assistance, consistent tight shot groups, maintaining same sight picture when firing, controlling breathing so weapon does not

move when firing, and squeezing the trigger so weapon does not move when firing. Getting a zero with no assistance, regardless of the sight, was marked by the highest percentage of Soldiers as needing more practice (48%) and as difficult to learn (36%) (see Table C-26). Getting tight shot groups and maintaining the same sight picture were next in terms of needing practice and difficult to learn (percentages ranged from 28% to 36%). Controlling breathing and trigger squeeze were typically marked by 25% as needing more practice and by 21% as difficult to learn.

Target engagement. The target engagement skills were hitting targets at 250 and 300 meters, adjusting point of aim to hit targets, and hitting multiple targets exposed at the same time. Hitting distant targets was marked as needing more practice by a high percentage Soldiers (68%) (see Table C-29), and as difficult to learn by 47%. The other two skills were less problematic for Soldiers.

Change in skills. Soldiers were asked whether there was a point in training where they became very confident in their marksmanship skills. This was an open-ended item. Overall 66% responded as "yes," with another 24% indicating they were confident of their weapon skills at the start of training. Then they were asked to indicate at what stage of marksmanship training they became confident. This was an open-ended question, but analysis of the responses indicated that over 50% of the responses were accounted for by three critical events (see Table C-31). Table 28 shows these responses as a function of the firing sequence and order of events within each sequence. With the CFF first sequence, the two primary events that led to confidence were CFF and AQ practice. But with the AQ first sequence, the two primary events were AQ practice and record fire. In general, it appeared that first two major firing events led to Soldier confidence; a third event did not contribute substantially to confidence.

Table 28
Stage of Marksmanship Training Where Soldiers Became Confident

CCF First (CFF-AQ)		AQ First (AQ-CFF)	
Training Stage	% Soldiers	Training Stage	% Soldiers
CFF	22%	AQ Practice Record	20%
AQ Practice Record	20%	AQ Record Fire	29%
AQ Record Fire	9%	CFF	9%
Cumulative % Soldiers	51%		58%

The last question focused on Soldiers' perception of their level of skill when they started marksmanship training and at the end of training. A ten-point scale was used, where only the two extreme points were labeled. A "1" meant a "low or minimal level of skill, need much more practice" and a "10" meant a "high level of skill, can't get much better." Figure 11 shows the distribution of these ratings. At the start of training the most common response was 1; at the end of training the most common responses were 7s and 8s, showing a clear shift in perceived marksmanship skill.

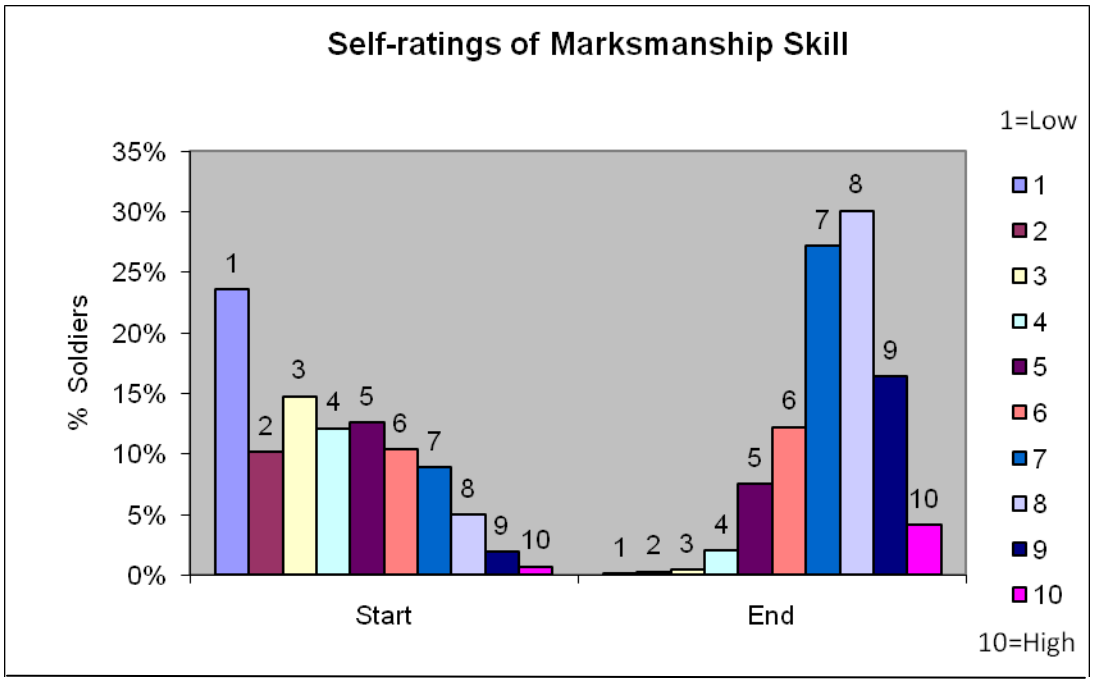

Figure 11. Soldier self-ratings of marksmanship skill at the start and end of marksmanship training.

Company Commander Input

All except one of the company commanders were Infantry, but their time in command varied. Four had not previously been a commander, three had commanded two prior training cycles, and three had commanded in three prior training cycles. Of interest, is that the lowest four companies on AQ scores had company commanders with no prior command experience. The experience of the company 1SGs was more varied, with previous cycles as a 1SG varying from none to 9 cycles. Three had been squad designated marksmen, two had been trained as Snipers, and one had been to the Special Operations Target Interdiction Course. Four had not had any of these special marksmanship courses or experience.

The background of the DSs primarily reflected the structure of the unit in which they served. All DSs within an OSUT company should be 11B (Infantry MOS). This was the case for all but one company. For the Infantry OSUT companies in a BCT brigade, 76% of the DSs were 11Bs, but for the BCT companies in the BCT brigade, only 31% of the DSs were 11Bs. The DSs (n = 14) who had been a squad designated marksman or who had attended Sniper School were concentrated in the OSUT companies. Only one drill sergeant from the BCT companies had been a squad designated marksman; none had attended Sniper School.

Given the limited sample of companies, it was difficult to determine relationships between the experience of the company leadership and cadre and Soldier performance. Complete data on cadre experience were available on nine of the ten companies. A few points can be made about the distribution of trainer/leader experience and its relationship to

performance. First, the two highest scoring companies had company commanders who had been in command for either two or three prior cycles; the 1SGs had had nine and four prior cycles; all DSs had experienced at least one prior training cycle. In the two lowest scoring companies, all DSs had also had experienced at least one prior training cycle, but in each case the company commanders were new and the 1SGs had the least experience with only two or three prior cycles. The company that was the third lowest performing company had a new company commander, a new 1SG, and two new DSs. The companies scoring in the middle all had company commanders with prior command experience; all but one had 1SGs with prior experience, but this 1SG had been a DS. Another element common to these companies was that all had some DSs who were new. The company numbers ranged from three to five new DSs with a mean of 3.75 (36% of the DSs). In addition, there were relative few DSs who had experienced one to three prior training cycles.

In summary, higher scoring companies had senior leaders (company commander and/or 1SG) with prior experience in those duty positions. The two highest companies also had no new DSs; each also had two DSs trained as snipers. The two lowest companies did not have experienced senior leadership. Companies in the middle typically had experienced senior leaders, but about one-third of their cadre was new DSs. In addition, considering all companies there was no relationship between Soldier performance and companies having one or two DSs with seven or eight prior training cycles.

Company commanders indicated what could have impacted their company results. The company commander of the second highest scoring company provided the following response, indicating the criticality of cadre competence and experience.

> There were several key takeaways. … The first was the current makeup of cadre for the company. At the time BRM/ARM was executed for this cycle all drill sergeants / instructors had been through at least one training cycle in this company. When formulating a plan for the instructional period, everyone was familiar with the primary instructor, commander's intent, and Bde lesson plans. All drill sergeants were comfortable and familiar with all instructional periods. There was no integration period for new trainers, which allowed all instructors to be actively engaged in training. Secondly, this BRM/ARM period was executed with 11 drill sergeants assigned to my company. When the drill sergeant to Soldier ratio is increased, more hands-on time is spent coaching the fundamentals of marksmanship. BRM 1-3 provide the foundation that sets the tone for all remaining periods of marksmanship. When trainees leave the initial level of training with sound fundamentals they require less coaching and oversight throughout the remaining periods. Another important factor was the size of the class. We trained 172 firers versus the regular class size of 220. Lastly, the experience level of certain cadre members had an impact on the results of training. Two of the primary instructor drill sergeants are trained snipers and have spent extensive time in operational units perfecting their training. The subject matter expertise of these individuals enhanced the overall quality of instruction throughout the marksmanship study.

Implementing and Training CFF

During the research, several lessons were learned about implementing and training for CFF. Some lessons pertained to the equipment and range facilities necessary to implement CFF. Other lessons related more directly to the training of Soldiers.

Equipment and range facilities. Lessons were learned regarding what equipment and range capabilities were necessary to execute CFF.

Dummy round. For safety purposes, the approved dummy round, M199 A060, had to be used. Expended rounds could not be used as they created actual malfunctions. In addition, we learned the usage life of a dummy round is limited and created actual malfunctions in the rifle with repeated use. Rounds were good for about 3 to 5 firing orders.

Barricade-platform configuration. The design of the barricade - platform configuration was critical. During the research, standard plywood barricades were built, which accommodated both tall and short Soldiers. However, these configurations impacted the firing positions. Figure 12 illustrates the differences in these configurations on the two ranges used in the research. The configuration on range X did not allow the Soldier to fire from the prone position using the barricade for concealment, whereas the configuration on range Y did. Soldiers on range X positioned themselves on the ground when firing from the prone position. Soldiers were to change their magazines behind the barricade, using it as cover/concealment, which was not possible if a magazine change occurred in the prone position. Also, as shown in Figure 12, the barricade brace interfered with the prone position on range Y. Thus the barricade-platform configurations impacted how Soldiers practiced and performed critical skills.

Another lesson learned was that Soldiers who fired from behind the barricade in the kneeling position needed to position themselves so they were able to scan the entire sector of fire. It was learned in the interviews that some who fired from the notch in the barricade were not able to see short-range targets as the close proximity of their body to the vertical portion of the barricade obscured their view.

During the research there was some confusion regarding how the barricade was to be used, e.g., for cover and concealment in all positions. This issue must be resolved when CFF is formally integrated in the POI.

***Zeroing*.** Companies had to confirm zero at distance (vice only a 25-meter zero). Either the LOMAH (location of misses and hits) or a KD range could be used for this purpose. The existing LOMAH software was designed to confirm a 300-meter zero setting on the M16A2 rifle with iron sights using 3-round shot groups. The software zeroing routine did not accommodate 5-round shot groups, a 200-meter zero, the M4 carbine, and the M68 (CCO) sight. Another software routine that accommodated shooting 5-round shot groups was used. However, the DS's decision of whether the shot group was the right size and in the right location was totally subjective as opposed to the very precise software algorithm/feedback provided by the LOMAH software for 3-round shot groups and a 300-meter zero. A major recommendation from the research was to update the LOMAH software to accommodate different zeroing distances,

variations in the number of rounds in a shot group, and different weapon sights and weapons. The KD range used by some companies to confirm zero did not present the problems associated with the LOMAH range.

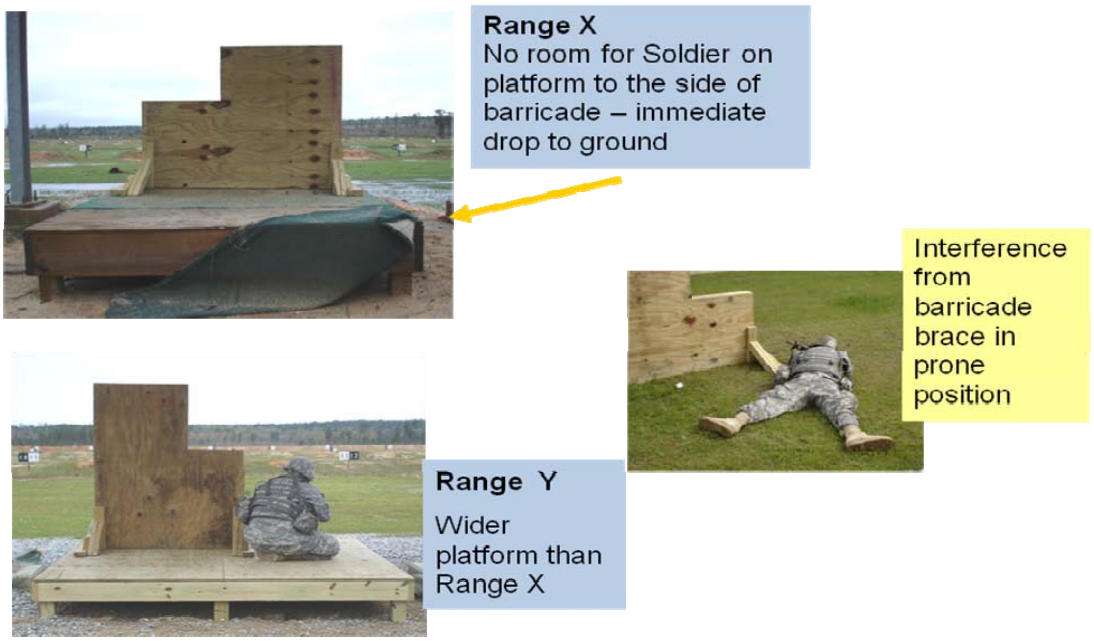

Figure 12. Barricade - platform configurations.

Another lesson learned was there was a need for a standard 200-meter target for the companies zeroing for 200 meters. No standard target existed. Thus there was confusion regarding the appropriate standard for a 200-meter zero for the weapons and sights used in the research.

CFF training. Soldier success was dependent on several training factors, which are described in this section.

***Unintended consequences from malfunction procedures and changing magazines*.** An unintended consequence was that not all Soldiers performed all malfunction steps when reacting to a dummy round. The acronym for this task is SPORTS.

S: Slap upward on magazine to make sure it is seated
P: Pull the charging handle all the way back
O: Observe the ejection of the cartridge; look into the chamber, check for obstructions
R: Release the charging handle to feed a new round in the chamber
T: Tap the forward assist
S: Squeeze. If the rifle does not fire. inspect to determine the cause of the stoppage and take appropriate remedial action.

Some Soldiers only did the "P" of SPORTS. There were at least two negative outcomes with taking a short-cut on correcting malfunctions. One outcome was that unless all steps were performed, the cartridge did not always eject and the next time the Soldier shot, a "true" weapon jam occurred. When this happened, a DS was required to remedy this problem, rendering the Soldier unable to engage many targets. Weapon jams happened with some frequency for Soldiers who took short-cuts. The second negative outcome was that Soldiers practiced the task incorrectly, which can transfer to a lull in suppressive fire on the battlefield and creating the potential for casualties.

Another unintended consequence was that some Soldiers did not seek cover/concealment when changing magazines. Again, this was negative practice.

Diagnosing Soldier problems. We also learned that the complexity of CFF makes it hard to diagnose Soldier problems. With AQ, the score sheet shows hits/misses by position and target distance; it is relatively easy to tell if a certain position is causing difficulties or targets at certain distances are problematic. However, with CFF, there are multiple other reasons for problems and the typical problems associated with target distance and position do not apply in most instances. As indicated previously, the problem may be a failure to see a target come up again, a magazine change, a dummy round, repeatedly firing and missing at a target and wasting ammunition, no ammunition remaining, a weapon jam, etc. The range printout has no indicators of these problems. The way to diagnose problems is to watch the Soldier. During the research, typically 12 lanes were used and there were about 3-4 DSs monitoring the lanes. Given this ratio of DSs to Soldiers, it was not possible to observe every Soldier.

As the first iteration of CFF was fired in the morning and the second iteration in the afternoon, there was limited time for remediation for Soldiers who performed poorly. Based on the interviews, those who did well were able to determine how they might improve the second time. But those who did poorly were not able to verbalize their problems and determine how to resolve them. The complexity of CFF seemed to overwhelm them. In the future, DSs need to work with these Soldiers to help improve their performance. A greater increase in scores from the initial iteration to the second iteration of CFF might occur if poorly performing Soldiers have remedial training between the two iterations.

In general, short, not medium or tall, Soldiers, indicated they had problems engaging targets from the barricade position. It was difficult or uncomfortable for them. Special attention should be paid to these Soldiers in training so they know how to get a stable position and can scan their entire sector of fire.

Train for skill integration. Another lesson learned was the need to train for skill integration versus training CFF-related skills in isolation. For example, instead of only focusing on the motor skills required to make a rapid magazine change, a Soldier should progress from executing a rapid magazine change to changing magazines with concealment while assuming a stable firing position again and then reaquire a good sight picture. Targets that "bob" could be incorporated into training. Soldiers need training on making decisions regarding the sequence of engaging targets. Concurrent training exercises that stress CFF skills should be developed.

Discussion

The data from the CFF lane observation sheets were critical to understanding Soldier performance on CFF. The results showed clear differences among the marksmanship categories, and training problems as a function of marksmanship skill. The shooting patterns revealed the criticality of integrating skills as well as possessing fundamental marksmanship skills. Clear distinctions were able to be drawn between CFF and standard Army qualification from the shooting profiles. Special analytic techniques were developed to code the shooting patterns, which provided a rich data set that went beyond the customary hit/miss by target and total score. We also found that Soldiers in IET can be trained to be reliable data collectors. Without the lane data and the associated analyses, none of the insights and findings regarding CFF would have been possible.

The pilot work was essential to research execution. Dummy round loading procedures were developed and refined. The CFF lane observation sheets were tested and revised with Soldiers to ensure they were usable, user-friendly, and provided the essential information. The Soldier surveys were piloted to check for question ambiguity, question format, and time to administer.

The number of rounds fired in CFF is limited, less than the current record fire and certainly less than used in many prior Army qualification courses of fire. More rounds in combination with another firing position would probably provide a more reliable index of proficiency. We understood that the number of rounds was based on ammunition availability and that constrained the scenario.

Summary and Conclusions

Historical Precedents to CFF

A review of Army marksmanship FMs published since 1940 showed that elements of CFF had been in previous record fire courses, but that no record fire course included all CFF elements. In particular, some courses included barricades and other obstacles for firing positions, more rounds than targets, or an array of three targets. A course labeled “combat fire” involved a magazine change and more rounds than targets. However, none of these courses included introducing a malfunction with a dummy round, different target exposure times for targets within an array, targets than bobbed upon being hit, and more than one magazine change across firing tables. Although historical precedents for complex firing scenarios existed, none of the courses of fire was as challenging as CFF.

The CFF scenario is more demanding and complex than the current Army record fire scenario. Unlike record fire, CFF is not a scenario where performance primarily reflects firing positions and target distance. In fact, other factors were found to be more important. Obviously, the requirements to change magazines and to react to a simulated malfunction using dummy rounds affected Soldiers. But target exposure time within an array impacted performance. Soldiers engaged target arrays, not single targets. For an array, Soldiers had four to seven target exposures, if they were successful in hitting all targets. Decisions regarding the sequence of

engaging targets within an array as well as whether to fire again if a target was not hit impacted Soldier success and ammunition available. Target engagements were not independent. Soldier performance in the first firing table influenced the second firing table which in turn influenced the third firing table. Effects were cumulative. Just as important, however, was that the performance results showed Soldier skill with marksmanship fundamentals was, in fact, fundamental to CFF success.

Soldiers who performed well generally had positive comments about CFF and were able to state the strategies they used (scanned their sector of fire, stayed calm, aware of target exposure times and location) and how they benefited from the first iteration, using it as a learning opportunity. Soldiers who did not perform well had problems with the basics (getting a good sight picture, firing from the kneeling and barricade positions). They fired repeatedly at a target to hit it even though they knew they were consuming ammunition. They did not benefit greatly from the first iteration, and often reacted emotionally to shooting problems.

Placement of CFF in Marksmanship Training

Based on Soldier performance and Soldier reactions, the recommendation was to include CFF in ARM, not BRM. The sequence of firing AQ and CFF made a difference. More Soldiers said the CFF-specific skills of changing magazines, correcting malfunctions, and remembering to scan for bobbing targets were difficult when CFF was in BRM (executed first) than when CFF was in ARM (executed second). In fact, the percentage of Soldiers who found it difficult to change magazines was more than eight-fold higher when CFF was executed in BRM. When asked which scenario gave them the most confidence, Soldiers indicated they gained more confidence from the second scenario. However, the percentage of Soldiers indicating a gain in confidence from CFF was twice as high when CFF was in ARM than when it was in BRM Soldiers also indicated that firing the first scenario increased their confidence on the second, but more Soldiers indicated that firing AQ before CFF instilled more confidence than vice versa. In addition, twice as many Soldiers indicated they were uncertain of their skills when CFF was fired in BRM.

Sequence of fire effects occurred on AQ scores and CFF hits. These results tended to support placing CFF in ARM than BRM as performance on both CFF and AQ was slightly higher (not significantly) for Soldiers who fired AQ in BRM. However, Soldiers who shot with iron sights performed significantly poorer when CFF was first.

In addition, the POIs interacted with the sequence of fire during BRM. When the training corresponded with the scenario fired at the end of BRM, scores were higher on that scenario than when the training did not directly support the scenario. The Current POI stressed some CFF skills in BRM, but the Legacy POI stressed AQ skills in BRM and delayed CFF skill training until ARM. We found that when CFF was fired in BRM, Soldiers in the Current POI performed better on CFF than did Soldiers in the Legacy POI. However, when AQ was fired in BRM, Soldiers in the Legacy POI performed better on AQ than did Soldiers in the Current POI. During ARM, such effects disappeared.

Given the increase in complexity of marksmanship skills required in CFF and consistent with the Army's training philosophy of crawl, walk, and run, it was recommended that BRM should focus on the fundamentals of shooting required by AQ, and CFF techniques should be introduced in ARM after shooting fundamentals are confirmed in BRM.

CFF Execution and Training Implications

CFF execution issues were found during the research. In order to have a random distribution of dummy rounds, a specific procedure had to be developed for use during the research by the ammunition detail. This procedure was accepted as a standing operating procedure for the ammunition detail. During the research there was some confusion regarding the use of the barricade for cover/concealment during CFF, and how to zero for 200 meters at 25 meters and at distance. Recommendations were made regarding the need to clarify the use of the barricade, to create a 200-meter zero target, and to modify LOMAH software to accommodate 5-round shot groups, a 200-meter zero, and the M68 weapon sight.

Training lessons learned included the need to stress integration of skills such as progressing from basic motor skills involved in changing a magazine to changing a magazine with concealment then assuming a stable firing position and reacquiring a good sight picture. The importance of making good decisions on the sequence with which targets are engaged was stressed. Another recommendation was for DSs to watch Soldiers to ensure they perform all the steps in correcting malfunctions and they use the barricade for concealment when changing magazines.

In general, most Soldiers benefited from the first iteration of CFF, so practice did improve performance. The relative improvement in scores was about the same as that which occurred from AQ practice fire to record fire (8% for AQ, 9% and 12% for CFF hits and points respectively). The results showed that CFF was not the same as AQ, and that marksmanship categories on one scenario did not necessarily relate to marksmanship categories on the other scenario. In essence the best indicator of Soldiers who did not qualify on AQ was Soldiers who did not meet the qualification on AQ practice record. This finding reinforced the DSs' tendency to give remedial training Soldiers who performed poorly during practice record fire. The best indicator of Soldiers who did not qualify on CFF was Soldiers who did not meet the qualification cut-point on CFF practice. It was harder to predict who would become Experts on either AQ or CFF. Experts on the record fire iteration of each scenario were likely to be those who met Sharpshooter or Expert standards on each scenario.

CFF Standards

Given a maximum of 26 hits in CFF, the following marksmanship standards were determined: Expert, 24-26; Sharpshooter, 21-23; Marksman, 16-20; Unqualified, below 16. These marksmanship categories were converted to the Army's TPU training categories as follows: Expert equivalent to T (Trained); Sharpshooter and Marksman equivalent to P (Needs Practice), and Unqualified equivalent to U (Not Trained). In addition, for a Go/NoGo standard, achieving 16 hits and above was recommended as the cut-point for a Go. Points was not

recommended as this score was not available on all ranges, was harder to interpret, and getting additional points for a kill did not affect Soldier motivation.

The distinction among the CFF marksmanship categories was supported by more than the total number of hits and the overall likelihood of killing targets. The CFF marksmanship categories were also directly related to proficiency in executing all CFF-specific skills. The percentage of Soldiers who achieved sufficient hits for a kill when a malfunction occurred and after changing magazines was highest with Experts, followed by Sharpshooters, then Marksmen, and lowest with Soldiers who did not qualify. The percentage of Soldiers who achieved kills with hits and no misses also systematically declined as a function of CFF marksmanship category. The percentage of Soldiers who had no ammunition for the last target was least for Experts and greatest for Soldiers in the Unqualified and Marksmanship categories. The percentage of Soldiers who never fired at targets or who did not fire as many times as required was also a direct function of marksmanship category, being least for the Experts and greatest for those who did not qualify.

The standards for CFF are likely to evolve as additional data are collected on Soldiers. One possibility is that kills may be considered as the standard. However, kills were found to be the least sensitive measure of marksmanship skill of all the scores examined (hits, points, and kills). Another factor that could impact standards is the Soldier population. One limitation of the current research was that the findings were based primarily on an initial entry training population. If CFF becomes a scenario used commonly in Forces Command, additional research with that target population would be warranted.

Major Recommendations

The sponsors of the research accepted the recommendation that CFF should occur in the ARM phase of marksmanship training as well as the guidelines for CFF standards. This information is being used by leaders as they make final decisions regarding the role of CFF in the marksmanship FM and the marksmanship POI. New marksmanship strategies being implemented in 2010 include CFF as the culminating exercises in advanced rifle marksmanship training.

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Appendix A

History of Army Marksmanship Record Fire Courses

This appendix presents the marksmanship qualification tables presented in rifle marksmanship field manuals (FMs), as well as information that clarifies the course of fire and the standards. In addition, information on the HumRRO and ARI research efforts are presented. The information is chronological, starting with the 1940 marksmanship FM and ending with the 2008 marksmanship FM. It duplicates some of the information in the body of the report in order to make Appendix A a complete document. Not all marksmanship FMs were located, but at least one FM in every ten-year period since 1940 was found. There was no change to the marksmanship FM in the 1990s.

The 1940 version of the marksmanship FM (FM 23-5, War Department) described courses under a section titled "Qualification Courses," but no performance standards were cited. Four courses were called "record practice," each consisting of a slow fire and rapid fire table. All positions involved the used of a sling, with either a hasty or loop adjustment. There was no time limit with the slow fire table. Rapid fire was either 60/65 or 30 seconds with 16 and 8 shots respectively. Positions were primarily sitting, kneeling and standing. The most frequent target distance was 200 yards, except for the last table which was 1000 inches.

Targets were bullseye and a life-size prone silhouette of a Soldier. "A" targets were bullseye targets used for 200 and 300 yards, with a center bullseye 10 inches in diameter and two outer rings, 26 and 46 inches in diameter respectively. Points assigned were 5, 4, and 3 respectively with 2 for a shot that was outside the rings. "B" targets were also bullseye used for 500 yards. The inner circle was 20 inches, and the two outer rings 37 and 53 inches respectively. The scoring procedure was the same as for the A target. The "D" target was a 6 ft square target with a black silhouette of a Soldier in the prone position. Five points were assigned to hits on the Soldier silhouette figure, with fewer points assigned the farther the shot was from the figure. The 1000 inch versions of the "A" and "D" targets represented a reduction in target scale from 200 yards to 1000 inches. Table A-1 presents the courses of fire in more detail.

Table A-1
Record Practice Courses in FM 23-5, US Rifle Caliber .30, M1, Dated 1940

Slow Fire	Description
Course A	200 yards, 4 shots, standing, A target 200 yards, 4 shots, sitting, A target 200 yards, 4 shots, kneeling, A target 500 yards, 8 shots, prone, B target
Course B	200 yards, 4 shots, standing, A target 200 yards, 4 shots, sitting, A target 200 yards, 4 shots, kneeling, A target
Course C	Same as Course B but position order was sitting, kneeling, standing

Slow Fire	Description
Course D	1000 in, 4 shots, kneeling, A-1000 in target 1000 in, 4 shots, standing, A-1000 in target 1000 in, 4 shots, sitting, A-1000 in target
Rapid Fire	
Course A	200 yards, 60 sec, 16 shots, sitting from standing, D target 200 yards, 60 sec, 16 shots, kneeling from standing, D target 300 yards, 65 sec, 16 shots, prone from standing, D target
Course B	200 yards, 60 sec, 16 shots, sitting from standing, D target 300 yards, 65 sec, 16 shots, kneeling from standing, D target
Course C	200 yards, 60 sec, 16 shots, kneeling from standing, D target 300 yards, 65 sec, 16 shots, prone from standing, D target
Course D	1000 in, 30 sec, 8 shots, sitting from standing, D-1000 in target 1000 in, 30 sec, 8 shots, prone from standing, D-1000 in target
Total # Rounds	184; 56 for slow fire and 128 for rapid fire.

The 1951 version of the marksmanship FM (FM 23-5, Department of the Army[DA] and the Air Force) was for the M1 rifle. Four tables were fired for record, with the total score across these tables determining the Soldier's classification. An Expert had to achieve 450 points; Sharpshooter, 360 points; and Marksman, 300 points. The maximum number of points was not specified, as the point assignments were not provided for two of the tables. But assuming the same scoring procedure was applied as in the 1940 version of FM 23-5, the maximum points would be 620.

Compared to the 1940 version of FM 23-5, slow fire and sustained fire, known distance tables with bullseye targets remained, primarily at 200 yards, and used the same positions. In addition, silhouette (E) targets were introduced. The third firing table involved 10 lanes, which placed the firer in different positions (standing foxhole, hubble pile, stump, window, prone [2 times], barricade, ditch, roof top, log) with distances from 125 to 500 yards. The fourth table was labeled quick fire (3-5 sec to engage). Targets were close, 15 to 35 yards; E silhouettes were used; firing positions were specified as shoulder or hip; exposures were short, from 3 to 5 sec. In this table, Soldiers had four more rounds than the required number of hits and were given extra points if they hit all targets and had unexpended rounds upon completion of firing. Table A-2 presents these firing tables in more detail.

Table A-2
Record Fire Tables in FM 23-5, US Rifle Caliber .30, M1, Dated 1951

Table	Description
Table IV KD Slow fire Course w/ Sling	100 yards, 10 min, 8 rounds, Standing position, A target 200 yards, 10 min, 8 rounds, Kneeling or Sitting, A target 200 yards, 10 min, 8 rounds, Squatting or Sitting, A target 300 yards, 10 min, 8 rounds, Prone, A target 500 yards, 12 min, 10 rounds, Prone, B targets Total # rounds: 42

Table	Description			
Table V KD, Sustained Fire Course w/ Sling	200 yards, 50 sec, 9 rounds, Squatting, Sitting or Kneeling from Standing, A target 300 yards, 50 sec, 9 rounds, Prone from Standing, A target Total # rounds: 18			
Table VII Transition Firing	Each lane, 4 rounds, 60 seconds, and E target, except for 500 yards with 1 B target. Total of 10 lanes. Total # rounds: 40			
	Lanes - Target distances and positions assigned to specific lanes. FM implied that, except for Lane 6, there were two targets one each lane.			Position
	Lane 1. 150-300 yards Lane 2. 200-400 yards Lane 3. 300-400 yards Lane 4. 200-325 yards Lane 5. 150-250 yards Lane 6. 500 yards Lane 7. 125-400 yards Lane 8. 250-350 yards Lane 9. 175-325 yards Lane 10. 125-275 yards			Standing foxhole Hubble pile Stump Window Prone Prone Barricade Ditch Roof top Log
	Scoring: Each hit assigned 5 points. 20 points for each lane. Total of 200 points.			
Table VIII Quick Fire	All firing positions were either shoulder or hip. 20 targets in table, but Soldier had 24 rounds; 8 per phase. All targets were silhouette targets.			
	First phase	15-35 yards	3 sec 3 sec 4 sec 3 sec	1 E 1 E 2 E 2 E
	Second phase	15-35 yards	4 sec 5 sec 5 sec	2 E 2 E 3 E
	Third Phase	15-45 yards	4 sec 5 sec 4 sec	2 E 3 E 2 E
	Scoring: 5 points assigned for each hit (100 points), and if all targets are hit, 5 points assigned for each unexpended round (20 points). Total of 120 points			

The cumulative score for firing Tables IV, V, VII, and VIII determined the Soldier's marksmanship classification. Minimum points were 450 for Expert, 360 for Sharpshooter, and 300 for Marksman. However, no scoring procedures were given for firing Tables IV and V. Assuming the same scoring procedure was followed as in the 1940 FM 23-5 (with A and B targets, 5 points for each hit), the total score would be 210 points for Table IV and 90 points for Table V. Considering all four tables the maximum possible score would be 620.

In 1958, FM 23-5 was updated by the Army (DA, 1958) (with a change in 1960 which also included an update to the metric system as required by Army Regulation 700-75 in May

1957). However, the information provided here is that documented in the 1958 version (not the metric change). The FM specified the qualification requirement as follows: "The rifleman's qualification classification is determined by the score he obtains by firing Table III. He must confirm this qualification by scoring at least the minimum requirement with Tables IV, V, and VI. (p 328)."

Table III, known distance, combined slow and rapid fire, incorporated standing, kneeling, sitting and prone positions (bullseye target) 100 to 500 yards. From a maximum score of 250, Expert had to achieve 212 points, Sharpshooter 187 points, and Marksman 160 points. Since the other three tables were fired to confirm qualification, only a minimum score was established for each, not scores for each marksman category. Two of the additional three tables, combat fire and quick fire tables, were similar to those in the 1951 version of FM 23-5. Two major differences were that the combat fire table included a moving target and several reaction or friendly targets. A hit on a reaction target resulted in a deduction of points. The FM also showed pictures of each of the ten firing positions in the combat fire table (foxhole, rubble pile, stump, window, bunker, prone, barricade, forward slope, rooftop and log). These pictures clarified the firing positions which were initially described in the 1951 version of the FM. The last table was a night fire table. None of these tables involved pop-up targets; pit operators provided all the markings of hits. See Table A-3 for details on these qualification requirements.

Table A-3
Record Fire Qualification Tables in FM 23-5, US Rifle Caliber .30, M1, Dated 1958

Table	Description	
Table III KD Target Not specified, assume bullseye "A" target per prior FM	100 yards, 8 min, 8 rounds, Standing 200 yards, 8 min, 8 rounds, Kneeling or squatting 200 yards, 50 sec, 9 rounds, Sitting (rapid) 300 yards, 8 min, 8 rounds, Prone 300 yards, 50 sec, 9 rounds, Prone (rapid) 500 yards, 8 min, 8 rounds, Prone	
	Scoring: 5 points per hit, total of 50 rounds. Total of 250 points. Expert - 212; Sharpshooter – 187; Marksman - 160	
Table IV Combat Position Firing	Each lane, 4 rounds, 30 sec, except Lane 6 (60 sec). Total of 40 rounds.	
	Lane Description. Targets placed at the distances cited	Position (Pictures of each shown in FM)
Table IV cont'd	Lane 1, 150-300 yards, 1F and 1E target Lane 2, 200-400 yards, 1F and 1E target Lane 3, 200-400 yards, 2E targets Lane 4, 200-325 yards, 1F and 1E target Lane 5, 150-250 yards, 2 moving E targets Lane 6, 500 yards, 1 vehicle silhouette Lane 7, 125-400 yards, 1F and 1E target Lane 8, 250-350 yards, 2E targets Lane 9, 175-325 yards, 1F and 1 E target	Foxhole Rubble pile Stump Window Bunker Prone Barricade Forward slope Rooftop

Table	Description			
	Lane 10, 125-275 yards, 1F and 1E target		Log	
	Scoring: Each hit assigned 5 points. 20 points for each lane, Total of 200 points. Minimum points to confirm qualification – 100.			
Table V Quick Fire	All firing positions were described as "underarm." 18 targets in the table, but Soldier had 24 rounds, 8 per phase. Targets were E and F silhouette			
	First phase	15-35 yards	3 sec 4 sec 4sec	1F 2F 1F and 1E
	Second phase	15-35 yards	4 sec 4 sec 4 sec 5 sec	1E and 1F 2 E 2 F 1E moving
	Third phase	15-45 yards	4 sec 3 sec 3 sec 3 sec 5 sec	2 F 1 E 1 F 1 E 1 E moving
	Scoring: 5 points assigned for each hit for 90 points maximum, and if all targets are hit, 5 points assigned for each unexpended round (30 points). Total of 120 points. Five points deducted for each reaction (friendly target) hit. Minimum points to confirm qualification - 65 points			
Table VI Night Firing	Quarter moon or less: 25 yards and 50 yards with M target. 8 rounds per target Greater than a quarter moon: 50 and 75 yards with M target, 8 rounds per target. Total of 16 rounds.			
	Scoring: 5 points per hit. Total of 80 points. Minimum points to confirm qualification - 25.			

TRAINFIRE I Research

In the 1950s, a major marksmanship effort was conducted by HumRRO (Human Resources Research Office) which was called TRAINFIRE (McFann, Hammes, & Taylor, 1955). This effort was initiated by the Army (Office of the Chief of Army Field Forces [OCAFF]) in response to a letter from a private citizen who presented basic ideas on improving rifle marksmanship training. A primary objective was to develop a different course of marksmanship instruction to better prepare the Soldiers to use their rifles in combat. Part of that objective involved developing new proficiency tests for measurement of marksmanship skill. The marksmanship FM at that time was FM 23-5, dated 1951, for the 30 caliber M1 rifle.

A major outcome of this effort was the invention of the pop-up olive drab silhouette target, a "killable" target, also nicknamed "Punchy Pete." This invention had a lasting impact on marksmanship training and proficiency assessment. It resulted in a major shift from using known distance bullseye targets to assess proficiency (qualification), to pop-up, briefly exposed silhouette type targets, colored olive draft to blend in with the natural terrain, which continue to

be used today. Another outcome was the introduction of targets at 50-yard increments (now 50-meter increments) for training and qualification. Also there was a shift from unsupported to supported firing positions.

One assumption of this research was that although combat situations cannot be duplicated in training, attempts must be made to determine those features of combat which are critical to combat firing and to simulate them as best as possible. One of the questions was whether the use of known distance firing using a bullseye target was a valid means of assessing combat-related skills. The TRAINFIRE I project was "an initial attempt to develop and evaluate a rifle marksmanship training program designed for maximum, rapid transfer to combat conditions, and to do this without neglecting the requirements of either safety or measurement. The effort has been to extract the elements of the combat problem and to reproduce them as closely as possible in training" (p. 7). Some examples of the nature of combat fire identified in this work were: enemy targets rarely visible except in a close assault, multiple enemy targets of men or objects under some type of cover, fleeting targets, most targets within 300 yards, prone position less likely to be used than standing foxhole or kneeling because of terrain and the nature of the target, low profile targets making it hard to select an accurate aiming point, and rifle fire rarely necessitating or permitting the use of windage adjustments.

Three critical skills were identified:

Detect targets – included the ability to locate hostile targets, mark positions with reference to nearby objects, and estimate range to target

Aim rifle at the target – included ability to zero the rifle (200 yards), align sights and get sight picture, apply hold-off for ranges greater than 200 yards, rapidly shift point of aim, and hold rifle steady

Fire rifle – included employing rapid, continuous movement to pull trigger

Two target devices were developed to help train the Soldier to fire a briefly exposed stationary target and a moving target. As mentioned, one device was the pop-up target system (later designated the M31A1 target holding device) that is used on almost all current marksmanship ranges. The other device was a hand-powered, moving target device, which simulated a moving human figure that suddenly appeared and then disappeared.

Much of the McFann et al. (1955) report described the changes to training that were examined. The summary here focuses on the proficiency test used to compare the programs of instruction. For the proficiency test, camouflaged (i.e., olive drab) pop-up and moving silhouette targets appeared at unknown distances to the firer and were momentarily exposed. The firer fired one round at each target; targets were presented randomly. The targets were placed at 50-yard increments from 50 to 350 yards to provide more precise measurement of marksmanship skill. Prior to this time, the distances between targets were not systematic. In the first phase of the test, the firer was in a standing foxhole position. Pop-up targets from 50 to 200 yards were exposed for 5 seconds; targets from 250 to 350 yards were exposed for 10 seconds. Moving targets at 100 yards were exposed for 5 seconds and those at 300 yards for 10 seconds. The firer had five clips of 8 rounds for a total of 40 rounds. The second phase of the test involved the firers starting from a standing supported foxhole position. Firers then moved down-range to a 50-yard marker and fired an additional two clips of 8 rounds each from an unsupported firing

position of their own choice. The targets were placed on the range in such a way that they did not disturb the terrain, thereby making the olive-draft silhouettes blend in with the natural foliage and brush. It took about 30 minutes to execute this test.

Table A-4
Tables of Fire in TRAINFIRE I Proficiency Test

Foxhole Supported – Meters to Target					Movement to unsupported position of firer's choice– Meters to Target	
Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7
250	50	300 M	50	300 M	250	200
300	350	250	350	100 M	300	300
100 M	100	100 M	100	100	150	150
150	200	150	200	200	350	350
50	300 M	50	300 M	250	100	100
350	250	350	100 M	300	200	200
100	100 M	100	100	100 M	300 M	300 M
200	150	200	200	150	250	100

Note. M stands for moving target.

No marksmanship categories were developed or applied in this experiment. However, the Soldiers' average number of hits for stationary targets was 19 (out of 44); the average hits for moving targets was 3 (out of 12).

Another test developed by HumRRO was a target detection course/range. Targets presented represented different degrees of exposure and ease of detection, ranging from motionless camouflaged targets, to slow moving targets (side to side or raising of head and shoulders), to more rapidly moving targets, to the target firing a blank round which provided cues of sound, flash and smoke.

FM 23-71

In 1957, FM 23-71 Rifle Marksmanship Course TRAINFIRE I was published, followed in 1958 by FM 23-72, Carbine Marksmanship Courses TRAINFIRE I. Only FM 23-72 for the carbine could be located for this report, but that FM stated that the marksmanship concepts in the two FMs were the same. The information here reflects what was in FM 23-72 for the carbine. The central skills for a Soldier were to detect targets, aim the carbine at the target, and fire without disarranging the aim. These same three skills were cited in the HumRRO report.

Although the FM title included the word "TRAINFIRE I," it did not replicate the TRAINFIRE proficiency test presented previously in Table A-4. However, consistent with the HumRRO work, the stated purpose of record firing was "to test the soldier's ability to detect and hit single combat type targets in their natural surroundings at unknown ranges and to detect and estimate ranges to single, stationary battlefield targets (FM 23-72, 1958, p. 142)." The pop-up "killable" target was used, but there were no moving targets. For the carbine, targets only went

to 200 meters; all targets were exposed for 5 seconds. (Note – it is assumed that the targets for the rifle went beyond 200 meters). The increment between targets was 50 meters. In addition, the technique of having a firer "move out" upon command, and then fire from an unsupported position after detecting a target was introduced. Seven tables with 8 targets per table (56 targets) were used in Record Fire I and in Record Fire II, with the combined scores from these two firings determining qualification. Out of 102 maximum points, the minimum qualification score for Expert was 68, for Sharpshooter, 54, and Marksman, 36. The target detection test used in the HumRRO research was also presented in the FM.

The record fire course (see Table A-5) required Soldiers to engage 32 pop-up targets at ranges from 50 to 200 meters from the foxhole position. This was done by firing at 8 targets in each of 4 lanes. It also required them to engage 24 pop-up targets from an unsupported position of their choice as they moved slowly forward. They engaged 8 targets in each of 3 lanes under these conditions. The Soldier had a total of 56 target exposures, with one round per target. No credit was given for unexpended rounds. The course was fired twice for record; once in the morning and once in the afternoon in order to equalize light conditions. Each shot was scored as a hit, miss or no fire.

Table A-5
Record Fire Qualification Tables in FM 23-72 Carbine Marksmanship Courses TRAINFIRE I, Dated June 1958

Record Fire I							
Round #	Mag 1 Spt Fox	Mag 2 Spt Fox	Mag 3 Spt Fox	Mag 4 Spt Fox	Mag 5 Unspt	Mag 6 Unspt	Mag 7 Unspt
	meters	meters	meters	meters	meters	meters	Meters
1	200	100	200	50	150 MO	200 MO	150 MO
2	100	200	150	200	200	200 MO	200 MO
3	200	200	100	100	100 MO	150	150 MO
4	150	150	200	200	50 MO	50	50
5	50	50	150	150	200	100 MO	200 MO
6	200	200	200	200	100	200 MO	100
7	100	100	100	200	200 MO	150	200
8	150	50	150	150	150 MO	200 MO	150 MO
Record Fire II Record Fire II tables identical to Record Fire I							

Note. MO stands for Move out.

FM 23-71, *Rifle Marksmanship,* published in December 1966 (DA, 1966) referenced the M14 rifle and the XM16E1. It superseded FM 23-71, dated July 1964. The M31A1 automatic target device was used, but was not computer-controlled at this time. It was electrically operated and could be centrally or individually controlled. Central control was through a switch that controlled all the targets in one bank. Hand scoring with hit, miss and no fire categories, was used. A whistle or bell was used to indicate when the exposure time ended. In addition, as documented in Change 1 to the FM, some changes were made to the bullseye targets which were used in known distance firing. Specifically, in the FM for the M1 rifle, the bullseye target A

used for 100 to 300 meters had 3 rings (scored 5, 4, 3). The new A target had 6 rings (scored 10, 9, 8, 7, 6, 5). Similar changes were made for the B target used at 500 meters. In both cases, the diameter of the outer ring was the same, and the diameter of the blackened center rings were very similar, but the scoring was more precise because of the doubling in the number of rings.

The Record Fire course (called "Record Firing" in the FM) had two primary phases, with several tables within each phase. Each phase had supported and unsupported firing positions. For Record Fire I, all targets were single exposures. The first four tables were fired from the foxhole, supported position, with 8 targets per table at distances of 50 to 350 meters (50 meter increments). Targets at 250 meters and beyond were exposed for 10 seconds; targets from 50 to 200 meters were exposed for 5 seconds. Soldiers were to rotate lanes as they progressed from the 1st to the 4th table. Soldiers had a magazine of 8 rounds and were instructed to fire one round per target. For the unsupported position phase of Record Fire I, there were three tables; each with 8 targets at distances of 100 to 350 meters. In this case, Soldiers fired from a position of their choice. Initially, the firer was in a standing position, and then on command was to move slowly to the 50-meter target (Move Out command). Upon target detection, they assumed a position of their own choice and fired. Again, only one round per target was allowed. They could change position for the next target. Within each table there were four additional commands to move, whereby they moved, detected target(s), and fired from a position of their choice. Soldiers changed lanes for each table. The tower operator raised and lowered the targets. A grader controlled the movement and served as a safety. In Record Fire I, the maximum possible score was 56 hits.

Record Fire II had two tables from a supported foxhole position, and one table from an unsupported position of the firer's choice. He assumed this unsupported position upon a command to move out and go to the 50 meter target. All were multiple target exposures, except for two targets in the first table. With multiple target exposures, two and three, all targets appeared simultaneously in the lane. When two targets were exposed the total time was 15 minutes; with three targets the time was 25 minutes. Targets were at the 100 to 350 meters distances on the range. With each of these tables, Soldiers were given additional rounds, the explanation being the added difficulty of engaging multiple targets. In the first table the firer had eight rounds to engage six targets; in the second, the firer had 16 rounds to engage 12 targets, and in the last table there were 16 rounds for 10 targets. The firer was not permitted to carry unexpended ammunition from one exercise to another. Unexpended rounds did not add to the total score. Each magazine had 8 rounds, and firers were directed to reload when necessary. Firers rotated lanes to fire each table. Targets were controlled by the tower. In Record Fire II, the maximum possible score was 28 hits.

In summary, in Record Fire I, there were 56 targets, with 1 round per target. In Record Fire II, there were 28 targets with 40 rounds allocated. Maximum possible score was 84. Expert was 60 and above, Sharpshooter was 45 to 59 inclusive, Marksman 30 to 44 inclusive, and Unqualified below 30. Change 2 to the FM (DA, 1968) made a minor change to one exposure time in the record fire course. Details on the course of fire are in Table A-6. Hits, misses and no fires were hand-scored.

Table A-6
Record Fire Course in FM 23-71, Rifle Marksmanship, Dated December 1966

Record Fire I, Single Exposures, Supported Phase, Foxhole position							
Table 1		Table 2		Table 3		Table 4	
Meters	Sec	Meters	Sec	Meters	Sec	Meters	Sec
250	10	100	5	250	10	50	5
300	10	250	10	150	5	200	5
200	5	300	10	100	5	100	5
150	5	100	5	200	5	200	5
50	5	50	5	250	10	150	5
350	10	350	10	300	10	250	10
100	5	100	5	350	10	300	10
200	5	200	5	200	5	150	5
Record Fire I, Single exposures, Unsupported Phase, Soldier selected positions							
Table 5		Table 6		Table 7			
Meters	Sec	Meters	Sec	Meters	Sec		
150 MO	5	250 MO	10	200 MO	5		
350	10	300 MO	10	300 MO	10		
100 MO	5	150	5	150 MO	5		
200 MO	5	250	10	350	10		
300	10	100 MO	5	300 MO	10		
200	5	200 MO	5	200	5		
250 MO	10	300	10	250	10		
150 MO	5	250 MO	10	150 MO	5		
Scoring for Record Fire I. 1 point for each hit for a total possible score of 56							
Record Fire II							
Table 1 Foxhole 8 rounds		Table 2 Foxhole 16 rounds [a]		Table 3 Unsupported 16 rounds [a]			
Meters	Sec	Meters	Sec	Meters	Sec		
150	5	100		100			
300	10 [b]	350	15	200	15		
100		200		150			
250	15	250	15	300	15		
50		100		100			
200	15	150	15	200	25		
		100		300			
		250	25	150			
		300		250	25		
		50		350			
		200	25				
		350					
Scoring for Record Fire II. One point per hit (28 targets).							

Note. MO stands for MOVE OUT

[a] Reload when necessary, 8 rounds in a clip

[b] With Change 2 this time was lengthened to 15 seconds

FM 23-9 (1974 plus Change 1 and Change 2)

In 1974, two FMs on marksmanship were published: FM 23-8 for the M14 and M14A1 rifle, and FM 23-9 for the M16A1 Rifle (DA, 1974a and b respectively). In FM 23-9, dated 1974, it was stated that it superseded FM 23-9, dated March 1970 as well as FM 23-71, dated December 1966. Only information on FM 23-9 for the M16A1 rifle are presented, as FM 23-8 on the M14 and M14 A1 rifles had the same qualification courses.

FM 23-9 stated that the goal of record firing was to produce combat proficient marksmen. In this FM, there were three phases to record fire (Record Fire I and II and night fire), with the qualification category based on the cumulative scores of these phases. In addition, minimum scores on Record Fire I and II were required to progress to the next phase. Record fire I and II each used 40 rounds with 40 targets (1 round per target). Record fire II included 10 quick fire targets. Night fire had 60 rounds, with a requirement of 20 hits. A minimum score of 20 was required on Record Fire I before progressing to Record Fire II. A minimum cumulative score of 47 was required for Record Fire I and II before progressing to Night Fire. Lastly, a minimum cumulative score of 54 from Record Fire I and II and Night fire was required to qualify. The total possible score was 100. Experts were 75 and above, Sharpshooter 66 through 74, Marksman 54 through 65, and Unqualified 53 and below.

Pop-up targets were used (M31A1 target holding mechanism). Distances to targets ranged from 50 to 300 meters; there were no 350 meter targets as had been specified in prior record fire courses.

Record Fire I had 4 tables, each with 10 targets. Soldiers had 4 magazines with 10 rounds each. Two tables were fired from the foxhole supported position and two from prone unsupported. Two tables consisted of only single targets; the two other tables had single, double and in one case triple target presentations. Exposure times were 5 seconds for targets between 50 to 200 meters and 10 seconds for 250 and 300 meter targets. With double targets, the exposures was 10 seconds if both targets were 200 meters or less, 15 seconds if one or both targets were beyond 200 meters, and 20 seconds for triple target exposures.

Record Fire II had 4 tables, each with 10 targets. Soldiers had 4 magazines with 10 rounds each. Table 1 was foxhole position with single, double and triple target presentations. With the other three tables, the firer was to engage from a position of choice while advancing from the foxhole location toward the target line in response to a command. Once a target was detected, the firer assumed the position of choice. This move out (MO) procedure was consistent with prior FM 23-71 dated 1966. Each firer engaged a total of 10 quick fire targets across these three tables. The targets were at 25 meters; exposure time was three seconds (single and double exposure).

Night fire targets were at 25 and 50 meters, with 30 rounds allocated for each target. Use of three-round bursts was recommended, as was bipod supported prone position. The firer had 4 magazines with 15 rounds each. Details on this course of fire are in Table A-7.

Table A-7
Record Fire Qualification Tables in FM 23-9, M16A1 Rifle and Rifle Marksmanship, Dated 1974

Record Fire I							
Table 1 Foxhole Supported		Table 2 Foxhole supported		Table 3 Prone Unsupported		Table 4 Prone Unsupported	
Range (meters)	Time (sec)	Range (m)	Range (m)	Range (m))	Time (sec)	Range (m)	Time (sec)
200	5	100	15	50	5	100	15
150	5	250		200	5	150	
250	10	300	15	100	5	300	10
300	10	50		150	5	50	10
50	5	150	10	300	10	200	
150	5	100		250	10	150	15
100	5	150	20	50	5	300	
250	10	50		200	5	50	10
200	5	250		150	5	200	
100	5	200	5	250	10	100	5
20 hits required to progress to Record Fire II							
Record Fire II							
Table 1 Foxhole Supported		Table 2 Optional Position		Table 3 Optional Position		Table 4 Optional Position	
Range (meters)	Time (sec)	Range (m)	Time (sec)	Range (m)	Time (sec)	Range (m)	Time (sec)
150	5	100 MO	10	100 MO	20	150 MO	15
300	10	200		250		300	
100	10	250 MO	15	150		150 MO	20
200		300		100 MO	10	200	
150	15	250 MO	15	200		250	
250		100		150 MO	10	25 MO	3
100	20	250 MO	10	200		25 MO	3
300		300 MO	10	25 MO	3	25	
200		25 MO	3	25		25 MO	3
300	10	25		25 MO	3	25	
Cumulative score of 47 required to progress to Night Fire							
Night Fire	25 meters: Rounds 1-30; 50 meters: Rounds 31-60						

ARI Marksmanship Research: 1978 – 1985

In the late 1970s, ARI initiated a research program on M16A1 rifle marksmanship (Smith, Osborne, Thompson & Morey, 1980). Products from this research effort, including a new program of instruction (POI), were tested on a large sample of Soldiers and was approved for implementation Army-wide. The POI stressed simplified fundamentals of shooting, a

building-block approach to instruction, and performance feedback. In addition, a new zeroing target was developed for the M16A1.

Another product of this effort was Field Circular (FC) 23-11 (1984), *Unit Rifle Marksmanship Training Guide* (see also Osborne & Smith, 1985). Contained in that guide were references to changes in the record fire table. The prior course was simply described as 40 targets exposed at ranges from 50 to 300 meters which the Army Training Centers used prior to 1982. The new course of fire also had 40 targets at 50 to 300 meters. Primary changes were stated as "a half dozen targets are exposed at a closer range, the exposure time has been reduced by an average of 30%, and the number of target hits required for qualification has been increased (p. 21-1)." No additional explanation for the changes was provided. A comparison of the new and the old qualification standards was presented in the FC (p. 21-2). These cut-points for marksmanship categories on the 40-round record fire course are current today (2009).

Rating	Old	New
Expert	28-40	36-40
Sharpshooter	24-27	30-35
Marksman	17-23	23-29
Unqualified	16-below	22-below

The Record Fire table in the FC is presented in Table A-8. Note that the exposure times were no longer in increments of 5 seconds as was previously the case. The FC also stated that if Soldiers did not qualify on the first attempt, when they refire and qualify they will be rated as a Marksman even if the number of targets hit is between 23 and 40.

Table A-8
Record Fire Qualification Table in FC 23-11, Unit Rifle Marksmanship Training Guide, Dated 1984

Table 1 Foxhole		Table 2 Foxhole		Table 3 Prone		Table 4 Prone	
Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)
50	3	100		100	5	150	6
200	6	200	8	250	8	300	9
100	4	150	10	150	6	100	
150	5	300		50		200	10
300	8	100	9	200	8	150	
250	7	250		150		250	12
50	3	200	6	200	12	100	
200	6	150	5	50		150	8
150	5	50	6	150	8	200	
250	7	100		100	5	100	9

FM 23-9 continued

Change 3 to FM 23-9 on M16A1 Rifle and Rifle Marksmanship, dated 1983, contained major changes to marksmanship qualification. It appears that Change 3 was greatly influenced by the ARI research, as the qualification scorecard is the same as that in FC 23-11, the Unit Marksmanship Guide, dated 1983, which was a product of the ARI research. That score card is presented in Table A-9. It is identical to the preceding Table A-8. In 1983, the firing positions were specified as foxhole supported and prone unsupported. Each soldier had 4 magazines, with 10 rounds for a total of 40 rounds. There were 40 targets. Qualification standards were: Expert 36-40, Sharpshooter 30-35, and Marksman 23-29.

Table A-9
Record Fire Qualification Tables in FM 23-9, M16A1 Rifle and Rifle Marksmanship, Change 3, Dated July 1983

Table 1		Table 2		Table 3		Table 4	
Foxhole Supported		Foxhole Supported		Prone Unsupported		Prone Unsupported	
Meters	Sec	Meters	Sec	Meters	Sec	Meters	Sec
50	3	100	8	100	5	150	6
200	6	200		250	8	300	9
100	4	150	10	150	6	100	10
150	5	300		50	8	200	
300	8	100	9	200		150	12
250	7	250		150	12	250	
50	3	200	6	200		100	8
200	6	150	5	50	8	150	
150	5	50	6	150		200	9
250	7	100		100	5	100	

Another addition to Change 3 was called “Combat Fire.” This course of fire did not remain in the later 1989 version of FM 23-9, but it did contain elements similar to the Combat Field Fire course examined in this report.

During Combat Fire, the Soldier fired at single and multiple targets with exposure times from 3 to 7 sec at ranges of 50 to 300 meters. The Soldier was issued more ammunition than target exposures (as in combat). Each scorecard table consisted of 20 exposures and the Soldier was issued one 10-round and one 15-round magazine per table. This allowed Soldiers to control their fire and to immediately re-engage a first-round miss if necessary. Soldiers also had to change magazines sometime during each table. The firers did this at their own speed without command from the tower. Rapid magazine change was viewed as critical to effective performance during combat fire. The Combat Fire score card is in Table A-10.

Table A-10
Combat Fire Score Card in FM 23-9, M16A1 Rifle and Rifle Marksmanship, Change 3, Dated July 1983

Round	Foxhole Supported		Prone Unsupported	
	Meters	Sec	Meters	Sec
1	250	5	200	4
2	200	4	150	4
3	300	5	250	5
4	200	4	200	6
5	150	4	100	
6	150	6	150	4
7	100		100	3
8	200	7	150	7
9	100		100	
10	50		50	
11	50	5	50	5
12	100		150	
13	50	3	100	6
14	150	4	200	
15	100	6	100	6
16	200		150	
17	150	7	100	6
18	250		200	
19	250	5	250	5
20	300	5	250	5

The next version of FM 23-9, *M16A1 and M16A2 Rifle Marksmanship*, was published in 1989 (DA, 1989). It superseded the Change 4 1985 version of this FM. The record fire table in this 1989 FM was basically the same as in the Change 3 in the 1983 version, with the same marksmanship category cutpoints. However, firing tables 1 and 2 were combined into a single table, with the firer given one 20-round magazine and the position for this table was a supported firing position. Similarly, firing tables 3 and 4 were combined into a single table, and the position was prone unsupported. The firer had one 20-round magazine. This record fire table is in Table A-11.

Table A-11
Record Fire Table in FM 23-9, M16A1 and M16A2 Rifle Marksmanship, Dated 1989

Table 1 Supported Fighting Position				Table 2 Prone Unsupported Position			
Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)
50	3	100		100	5	150	8[b]
200	6	200	8	250	8	300	9
100	4	150	10	150	6	100	
150	5	300		50		200	10
300	8	100	9	200	8	150	

Table 1 Supported Fighting Position				Table 2 Prone Unsupported Position			
Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)
250	7	250		150		250	12
50	3	200	6	200	12	100	
200	6	150	5	50		150	8
150	5	50	6	150	8	200	
250	7	100		100	8[a]	100	9

[a] The exposure time for this 100m target differed from that in the FC. In the FC, the exposure time was 5 seconds.
[b] The exposure time for this 150 m target differed from that in the FC. In the FC, the exposure time was 6 seconds.

The historical shift in the scores required for the different marksmanship categories cited in FC 23-11 was cited again in this version of FM 23-9. The FM also indicated that some Army ranges had been automated with computer support. However, it was clear, that not all Army ranges had been automated by 1989.

FM 3-22.9, Rifle Marksmanship M16A1, M16A2/3, M16A4, and M4 Carbine

FM 3-22.9 (DA, 2003) covered all versions of the M16 rifle as well as the M4 Carbine. It superseded the 1989 version of FM 23-9. Thus 14 years elapsed before the next update to the marksmanship FM. The record fire course was the same as that in FM 23 -9 (DA, 1989). The course applied to all M16 series rifles as well as the M4 Carbine (see Table A-12).

Table A-12
Record Fire Table in FM 3-22.9, Rifle Marksmanship M16A1, M16A2/A3, M16A4 and M4 Carbine, Dated 2003

Table 1 Supported Fighting Position				Table 2 Prone Unsupported Position			
Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)
50	3	100		100	5	150	8
200	6	200	8	250	8	300	9
100	4	150	10	150	6	100	
150	5	300		50		200	10
300	8	100	9	200	8	150	
250	7	250		150		250	12
50	3	200	6	200	12	100	
200	6	150	5	50		150	8
150	5	50	6	150	8	200	
250	7	100		100	8	100	9

Note. Based on DA Form 3595-R (Record Fire Scorecard, June 1989)

Change 4 to FM 3-22.9 (DA, September 2006) changed firing Table 2 of record fire (see Table A-12 above). Firing table 2 became two tables with 10 rounds each. Table 2 became

Prone Unsupported and Table 3 was Kneeling. The position for Table 1 was specified as either prone supported or foxhole supported. Table 2, prone supported, had single and double target exposures, with targets from 150 to 300 meters. Table 3, kneeling, had only single exposures with targets at only 3 distances, 50, 100 and 150 meters (see Table A-13). Qualification standards did not change: Expert 36-40; Sharpshooter 30-35; Marksman, 23-29, Unqualified 22 and below.

Table A-13
Record Fire Table in FM 3-22.9 Rifle Marksmanship M16A1, M16A2/A3, M16A4 and M4 Carbine, Change 4 Dated 2006

Table 1 Prone Supported or Foxhole Supported				Table 2 Prone Unsupported		Table 3 Kneeling	
Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)	Range(m)	Time(sec)
50	3	100		200	6	150	8
200	6	200	8	250	8	50	4
100	4	150	10	150	6	100	5
150	5	300		300		150	6
300	8	100	9	200	10	100	5
250	7	250		150		50	4
50	3	200	6	200	12	100	5
200	6	150	5	250		150	6
150	5	50	6	150	9	50	4
250	7	100		150	6	100	5

Note. Based on DA Form 3595-R, July 2006

FM 3-22.9 was updated in August 2008 and titled *Rifle Marksmanship M16-/M4-Series Weapons.* The record fire scenario was the same as that in Change 4 to the prior version of FM 3-22.9 (2006). Qualification cut-points, and the target distances and exposures were the same. A difference in the score card was that the position for Table 3 was specified as Unsupported Kneeling vice Kneeling.

Appendix B
Training Observation Form (Condensed)

The format of the data form used in the field accommodated all ten companies. The condensed version shown here illustrates only one company.

	POI: Current or Legacy
	Company (name) Sequence of fire: CFF then AQ or AQ then CFF
BRM 1-3	
Follow-through	
Prone supported (sandbags)	
Prone supported (magazine)	
Prone unsupported (elbows only)	
Kneeling	
BRM 4	
Black dot target	
3-round shot groups 5/6 standard	
5-round shot groups 8/10 standard	
Uniform S, G, F	
BRM 5	
200, 255, or 300 meter zero	
M16A4 Sights set at 8/3+2 or 8/3	
M4 BUIS set at 300 meters	
M16A4 BUIS set at white mark below 300 meters	
Uniform S, G, F	
Prone supported (sandbags)	
Prone supported (magazine)	
Prone unsupported (elbows)	
3-round shot groups 5/6 standard	

	POI: Current or Legacy
	Company (name) Sequence of fire: CFF then AQ or AQ then CFF
5-round shot groups 8/10 standard	
Standard target	
1.1-inch circle target	
M4/M4A1 Target for BUIS	
M16A2 Target for BUIS	
M16A2 Target for CCO	
CCO zeroed 1.5 cm below center mass	
Soldier adjust sights Drill Sergeant adjust sights	
BRM 6	
Slick Uniform	
Confirm Zero at Distance	
Down range feed back	
BRM 7-10/ARM 1-6 Write in BRM or ARM Period	
Induced stoppage	
Rapid Magazine change	
Kneeling (barricade supported)	
Standing (barricade supported)	

Notes.

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Appendix C

Soldier Questionnaire with Results

Appendix C presents the Soldier Questionnaire as well as questionnaire results. The results for each company are presented for each item, followed by a summary of all companies. Also for most items, summary breakouts by the two POIs and the two firing sequences are shown. The company summaries are the mean of the company data, so each company is weighted equally. Summary means are not impacted by company size.

The abbreviation "CQ" (for Combat Qualification) was used in the questionnaires to refer to Combat Field Fire (CFF) as that was the name given to the new course of fire when the questions were developed. The name was later changed to Combat Field Fire (CFF). The data tables in Appendix C use the abbreviation "CQ."

Association between company numbering in Appendix C and the research design (Table 8).

Company #	Research Design		
Co 1	Current POI	CQ first	M4 with CCO
Co 2	Current POI	CQ first	M16A4 with IS
Co 3	Current POI	AQ first	M16A4 with IS
Co 4	Current POI	AQ first	M4 with BUIS
Co 5	Current POI	AQ first	M4 with CCO
Co 6	Legacy POI	CQ first	M4 with CCO
Co 7	Legacy POI	CQ first	M16A4 with IS
Co 8	Legacy POI	AQ first	M4 with BUIS
Co 9	Legacy POI	AQ first	M4 with CCO
Co 10	Legacy POI	AQ first	M16A4 with IS

Note. There was no question 6 in the questionnaire.

PRIVACY ACT STATEMENT

This package contains a survey that was developed as part of the official research mission of the U.S. Army Research Institute for the Behavioral and Social Sciences (10 U.S. Code 2358). Researchers will combine information from this survey with marksmanship data to determine how Combat Qualification can best be utilized in Basic Combat Training (BCT). As authorized by Executive Order 9397, the forms request personal identifiers (e.g., Company and Roster number) to link data files together. *Full confidentiality for all Soldiers will be maintained during data processing and reporting.* Individual responses and results will NOT be reported to anyone in the chain of command and will in no way impact your Army career. While your participation is voluntary, successfully assessing the impressions of marksmanship programs requires the contribution of Soldiers like you. If you are willing to contribute to this research effort, please complete the following survey.

Marksmanship Questions

1. Did you qualify on your first attempt on Army qualification?
   Yes No

Table C-1
Comparison of Survey and Actual Results for Soldiers who Qualified on First Attempt at AQ

	% Qualified on First Attempt		% Qualified on First Attempt: Survey % minus Actual %	# of Soldiers		Ratio: Survey N to Actual N
Sequence and Company Number	Survey %	Actual %		Survey N	Actual N	
Current POI						
CQ first						
1	93%	93%	0	173	175	0.99
2	62%	57%	5	189	202	0.94
AQ first						
3	83%	70%	13	155	226	0.69
4	71%	70%	1	163	177	0.92
5	80%	80%	0	164	180	0.91
Legacy POI						
CQ first						
6	95%	93%	2	149	152	0.98
7	61%	53%	8	195	227	0.86
AQ First						
8	76%	76%	0	200	212	0.94
9	86%	86%	0	182	190	0.96
10	83%	83%	0	220	235	0.94

Note. The low survey return rate (.69) for Company 3 resulted from early pick-up of the Soldiers on the range by post transportation on the day the survey was administered. The slightly lower survey return rate for Company 7 was due to confusion in the procedures necessary to ensure Soldiers were directed to the survey location.

2. If you answered “Yes” (you qualified on the first attempt), check (✓) **ALL** the factors that may have contributed to this result.

a. Prior experience with rifle/weapons
b. Good zero on my weapon
c. Practice qualification gave me confidence
d. Had good training on marksmanship fundamentals
e. Had sufficient practice on marksmanship fundamentals
f. I was physically comfortable firing from all positions
g. Drill Sergeants spent additional time with me/my unit or gave specific guidance which helped me
h. Drill Sergeants motivated me to do well
i. I was calm; used techniques to keep calm and relaxed and was able to concentrate
j. Motivated because of family reasons
k. Had some good luck
l. Good weather

Table C-2. *Individual Company Results on Reasons Qualified on First Attempt – Percent Soldiers Marking Each Reason*

Current POI					
	CQ First		AQ First		
	Co 1 *(n = 161)*	Co 2 *(n = 118)*	Co 3 *(n = 129)*	Co 4 *(n = 116)*	Co 5 *(n = 131)*
a	57%	52%	44%	53%	61%
b	84%	71%	82%	89%	86%
c	81%	75%	81%	92%	59%
d	94%	86%	80%	97%	89%
e	85%	56%	60%	88%	69%
f	72%	69%	64%	66%	57%
g	76%	60%	53%	77%	47%
h	80%	91%	61%	72%	58%
i	72%	83%	78%	88%	79%
j	55%	61%	39%	39%	40%
k	19%	19%	25%	21%	17%
l	71%	69%	24%	9%	23%
Legacy POI					
	CQ First		AQ First		
	Co 6 *(n = 142)*	Co 7 *(n = 119)*	Co 8 *(n = 152)*	Co 9 *(n = 157)*	Co 10 *(n = 182)*
a	53%	48%	53%	54%	47%
b	82%	85%	88%	81%	84%
c	83%	82%	78%	76%	65%
d	92%	93%	88%	89%	86%
e	82%	74%	70%	68%	74%
f	68%	60%	64%	54%	57%
g	76%	66%	57%	69%	54%
h	82%	87%	57%	80%	55%
i	76%	84%	76%	67%	72%
j	47%	57%	38%	40%	35%
k	27%	24%	30%	22%	22%
l	54%	47%	36%	36%	39%

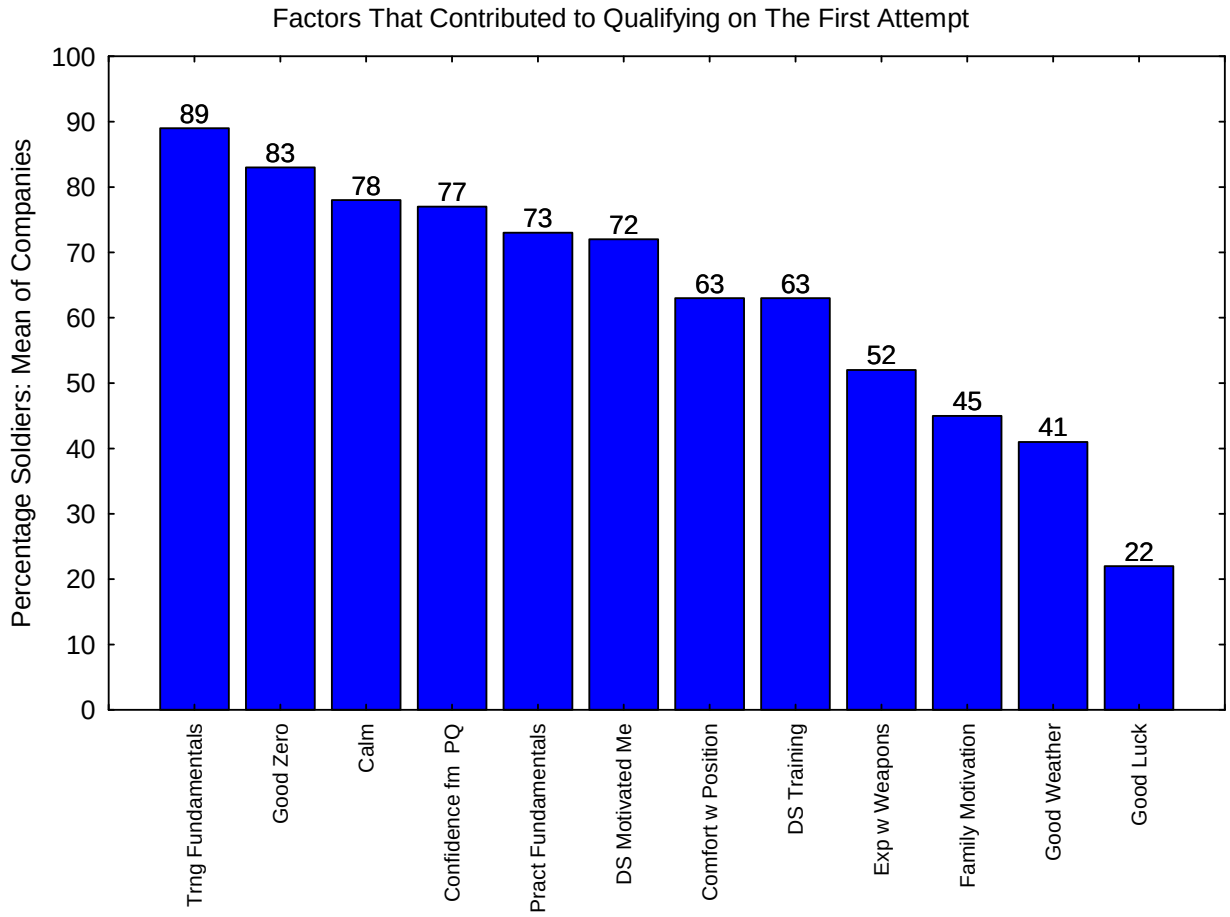

Figure C-1. Soldier perceptions of factors that contributed to qualifying on Army Qualification on the first attempt, ordered from most frequently marked to least frequently marked.

Table C-3. *Factors Contributing to Qualification by AQ Marksmanship Category*

Category	Reason for Qualifying on First Attempt	AQ Marksmanship Category		
		EX	SS	MM
Training	Good zero on my weapon	92%	89%	77%
Training	Had good training on marksmanship fundamentals	91%	93%	87%
Individual Difference(s)	I was calm; used techniques to keep calm and relaxed and was able to concentrate.	87%	82%	71%
Training	Had sufficient practice on marksmanship fundamentals	79%	78%	69%
Training	Practice qualification gave me confidence	76%	81%	74%
Training	Drill Sergeants motivated me to do well.	75%	77%	66%
Training	I was physically comfortable firing from all positions	79%	71%	53%
Training	Drill Sergeants spent additional time with me/my unit or gave specific guidance which helped me.	60%	67%	62%
Individual Difference(s)	Prior experience with rifle/weapons	59%	57%	47%
Random Factors	Good weather	52%	42%	40%
Personal	Motivated because of family reasons.	49%	45%	45%
Random Factors	Had some good luck	19%	21%	23%

Note: EX : n = 128 ; SS : n = 543 ; MM : n = 652

3. If you answered "No" (you did not qualify on the first attempt), check (✓) **ALL** the factors that may have contributed to this result.
   a No or limited prior experience with rifle/weapons
   b Poor zero on my weapon
   c Practice qualification did not give me the confidence I needed to qualify on my first attempt.
   d Needed more practice on marksmanship fundamentals
   e Missed some BRM training sessions
   f I was not physically comfortable firing from all positions
   g Difficult to fire in battle gear
   h Targets were hard to detect on my lane
   i Weapon malfunctioned when I fired
   j I was nervous
   k Got distracted
   l Glasses fogged up
   m Had some bad luck
   n Bad weather

Table C-4. *Individual Company Results on Reasons not Qualifying on First Attempt – Percent Soldiers Marking Each Reason*

	Current POI				
	CQ First		AQ First		
	Co 1 *(n = 12)*	Co 2 *(n = 71)*	Co 3 *(n = 26)*	Co 4 *(n = 47)*	Co 5 *(n = 33)*
a	25%	44%	42%	47%	39%
b	58%	31%	38%	23%	55%
c	8%	28%	12%	9%	18%
d	17%	35%	31%	26%	15%
e	17%	6%	8%	6%	15%
f	0%	18%	35%	28%	9%
g	25%	35%	38%	30%	18%
h	17%	30%	15%	13%	55%
i	17%	18%	35%	23%	15%
j	50%	46%	42%	34%	24%
k	0%	4%	4%	9%	3%
l	8%	38%	38%	47%	12%
m	33%	24%	27%	34%	33%
n	0%	13%	23%	53%	6%

Legacy POI					
	CQ First		AQ First		
	Co 6 *(n = 7)*	Co 7 *(n = 76)*	Co 8 *(n = 48)*	Co 9 *(n =25)*	Co 10 *(n = 38)*
a	43%	30%	42%	52%	37%
b	57%	26%	27%	48%	18%
c	14%	28%	17%	20%	24%
d	0%	38%	42%	24%	18%
e	14%	3%	4%	8%	3%
f	29%	28%	13%	4%	24%
g	14%	36%	33%	44%	42%
h	14%	8%	15%	4%	13%
i	14%	11%	25%	40%	21%
j	29%	50%	46%	36%	61%
k	0%	7%	6%	4%	11%
l	0%	17%	48%	12%	32%
m	14%	33%	25%	24%	34%
n	0%	0%	0%	12%	3%

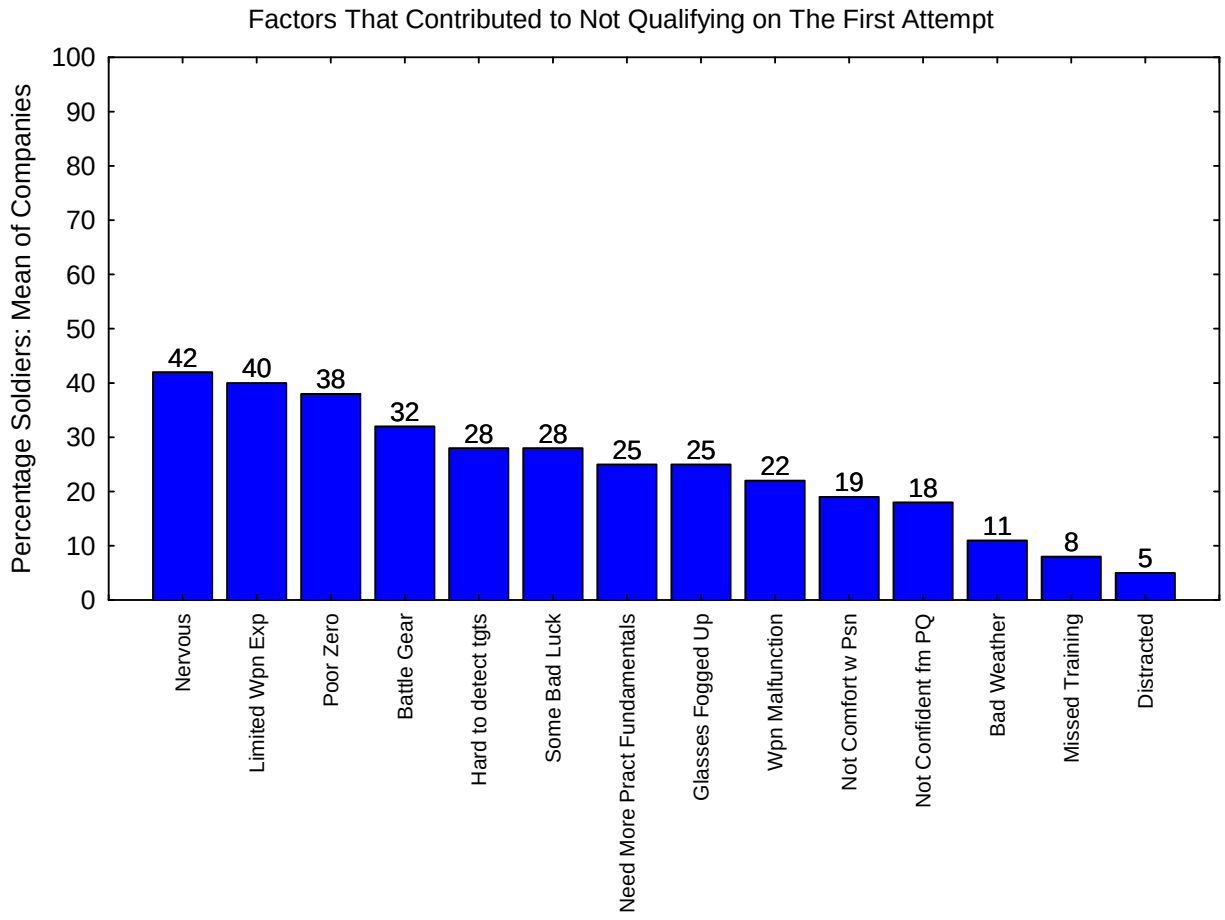

Figure C-2. Soldier perceptions of factors that contributed to not qualifying on Army Qualification on the first attempt, ordered from most frequently marked to least frequently marked.

Part I. Comparison of Army Qualification and Combat Qualification

4. Compare the difficulty you had using the following skills during Army Qualification and Combat Qualification. For each skill, indicate which qualification course was the most difficult.

Skills	Check ✓ **one** box for each Skill		
	Army Qual harder than Combat Qual	**Similar in Difficulty**	**Combat Qual harder** than Army Qual
a. Firing from a kneeling position	□	□	□
b. Hitting 250 & 300 meter targets	□	□	□
c. Hitting 50 & 100 meter targets	□	□	□
d. Detecting the targets in your lane.	□	□	□
e. Hitting multiple targets exposed at the same time	□	□	□

Table C-5. *Individual Company Results Comparing AQ and CQ on Difficulty of Common Skills: Percent Soldiers*

Company & Skills (a through e)	AQ harder	Similar	CQ harder
Current POI			
Co 1 CQ first (*n = 172-173*)			
a.	40%	45%	15%
b.	18%	58%	25%
c.	9%	83%	9%
d.	8%	74%	18%
e.	8%	71%	21%
Mean	16%	66%	18%
Co 2 CQ first (*n = 188-189*)			
a.	28%	57%	15%
b.	29%	42%	29%
c.	15%	68%	17%
d.	27%	63%	10%
e.	20%	61%	20%
Mean	24%	58%	18%
Co 3 AQ first (*n = 155*)			
a.	25%	68%	6%
b.	34%	54%	13%
c.	31%	54%	15%
d.	28%	60%	12%
e.	44%	37%	19%
Mean	32%	55%	13%
Co 4 AQ first (*n = 160-163*)			
a.	17%	65%	18%
b.	23%	54%	24%
c.	11%	80%	8%
d.	16%	64%	21%
e.	18%	54%	28%

Company & Skills (a through e)	AQ harder	Similar	CQ harder
Mean	17%	63%	20%
Co 5 AQ first (*n = 163-164*)			
a.	29%	61%	10%
b.	35%	49%	16%
c.	25%	69%	6%
d.	50%	41%	9%
e.	40%	41%	20%
Mean	36%	52%	12%
Legacy POI			
Co 6 CQ first (*n = 149*)			
a.	22%	64%	14%
b.	13%	62%	25%
c.	14%	77%	9%
d.	21%	59%	20%
e.	8%	72%	20%
Mean	16%	67%	18%
Co 7 CQ first (*n = 194*)			
a.	26%	57%	17%
b.	19%	59%	23%
c.	14%	68%	18%
d.	14%	68%	18%
e.	11%	70%	19%
Mean	17%	64%	19%
Co 8 AQ first (*n = 200*)			
a.	32%	55%	14%
b.	32%	53%	15%
c.	23%	68%	10%
d.	19%	66%	16%
e.	39%	50%	12%
Mean	29%	58%	13%
Co 9 AQ first (*n = 181-182*)			
a.	21%	65%	14%
b.	26%	52%	23%
c.	12%	77%	11%
d.	14%	65%	20%
e.	26%	59%	15%
Mean	20%	64%	17%
Co 10 AQ first (*n = 197-200*)			
a.	30%	42%	28%
b.	33%	44%	23%
c.	30%	56%	14%
d.	27%	49%	24%
e.	36%	51%	13%
Mean	31%	48%	20%

Table C-6
Summary of Company Means on Difficulty of Skills Common to AQ and CQ: Percent Soldiers

Rating	Skill					
	Hit 50-100m Targets	Detect Targets	Fire from Kneeling Position	Hit Multiple Targets	Hit 250-300m Targets	Mean for All Common Skills
Breakout by POI						
Current POI						
AQ Harder	28%	26%	18%	26%	26%	25%
Similar	59%	60%	71%	53%	53%	59%
CQ Harder	13%	14%	11%	22%	22%	15%
Legacy POI						
AQ Harder	18%	19%	26%	24%	25%	22%
Similar	69%	61%	57%	60%	54%	60%
CQ Harder	12%	20%	17%	26%	22%	16%
Breakout by Sequence						
CQ First						
AQ Harder	13%	18%	29%	12%	20%	18%
Similar	74%	66%	56%	68%	55%	64%
CQ Harder	13%	17%	15%	20%	25%	18%
AQ First						
AQ Harder	22%	26%	26%	34%	31%	27%
Similar	67%	58%	59%	49%	51%	57%
CQ Harder	11%	17%	15%	18%	19%	16%
All Companies						
AQ Harder	18%	22%	27%	25%	26%	24%
Similar	70%	61%	58%	57%	53%	60%
CQ Harder	12%	17%	15%	19%	22%	17%

Note. Skills ordered from high to low on total percentage of Soldiers indicating skill had similar degree of difficulty in AQ and CQ.

Combat Qualification required some other skills.

5. Were the following skills difficult for you to use during **Combat Qualification**? (Circle "Y" (Yes) if the skill was difficult for you; circle "N" (No) if the skill was not difficult.)

Y N a. Having a stable position when firing from a barricade
Y N b. Changing magazines quickly
Y N c. Correcting a malfunction in reaction to the dummy rounds
Y N d. Remembering to scan for targets that could bob up again after you had hit them once.
Y N e. Maintaining the same sight picture when changing positions in reaction to a malfunction or after changing magazines.

Table C-7

Individual Company Results on Percent Soldiers Indicating Skills Specific to CQ Were Difficult Versus Not Difficult: % Soldiers

	Current POI										Legacy POI									
	CQ First				AQ First						CQ First				AQ First					
	Co 1 *(n = 173)*		Co 2 *(n = 189)*		Co 3 *(n = 155)*		Co 4 *(n = 163)*		Co 5 *(n = 164)*		Co 6 *(n = 148)*		Co 7 *(n = 194)*		Co 8 *(n = 200)*		Co 9 *(n = 182)*		Co 10 *(n = 220)*	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
a	19	81	24	76	13	87	15	85	10	90	17	83	15	85	18	83	15	85	23	77
b	11	89	22	78	12	88	8	92	10	90	11	89	11	89	11	90	9	91	11	89
c	18	82	23	77	18	82	18	82	9	91	16	84	25	75	13	88	9	91	10	90
d	22	78	28	72	10	90	18	82	11	89	18	82	25	75	23	77	9	91	10	90
e	24	76	42	58	27	73	35	65	12	88	24	76	30	70	31	69	25	75	30	70

Table C-8

Summary of Company Means on Difficulty of Skills Specific to CQ: Percent Soldiers

Rating	Skill					
	Maintain Same Sight Picture	Remember to Scan for Targets	Stable Position from Barricade	Correcting Malfunction	Quick Magazine Change	Mean for All Specific Skills
Breakout by POI						
Current POI						
Difficult	28%	18%	16%	17%	13%	18%
Legacy POI						
Difficult	28%	17%	18%	15%	11%	18%
Breakout by Sequence						
CQ First						
Difficult	30%	23%	19%	21%	14%	21%
AQ First						
Difficult	27%	14%	16%	13%	10%	16%
All Companies						
Difficult	28%	17%	17%	16%	12%	18%

Note. Skills ordered from high to low on total percentage of Soldiers indicating skill was difficult.

7. Which qualification scenario gave you more confidence in your marksmanship skills? (Check ✓ one)

____ a. Army Qualification
____ b. Combat Qualification
____ c. They each gave me a similar degree of confidence

Table C-9
Individual Company Results on Confidence Produced by AQ Versus CQ: Percent Soldiers

	Current POI					Legacy POI				
	CQ First		AQ First			CQ First		AQ First		
	Co 1 *(n = 173)*	Co 2 *(n = 188)*	Co 3 *(n = 155)*	Co 4 *(n = 162)*	Co 5 *(n = 164)*	Co 6 *(n = 149)*	Co 7 *(n = 195)*	Co 8 *(n = 200)*	Co 9 *(n = 182)*	Co 10 *(n = 220)*
a	34	43	30	23	16	29	41	29	21	24
b	13	16	42	44	56	33	18	29	38	50
c	53	40	28	33	27	38	41	42	41	26

Table C-10
Summary of Company Means on Confidence Produced by AQ Versus CQ: Percent Soldiers

	AQ More Confidence	CQ More Confidence	Similar Degree of Confidence From Each
Breakout by POI			
Current POI	29%	34%	36%
Legacy POI	29%	34%	38%
Breakout by Sequence			
CQ First	37%	20%	43%
AQ First	24%	43%	33%
All Companies			
Difficult	29%	33%	37%

8. Which qualification scenario was more difficult for you? (Check ✓ one)

____ a. Army Qualification
____ b. Combat Qualification
____ c. They were about the same

Table C-11
Individual Company Results on Difficulty of AQ Versus CQ: Percent Soldiers

	Current POI					Legacy POI				
	CQ First		AQ First			CQ First		AQ First		
	Co 1 *(n = 173)*	Co 2 *(n = 189)*	Co 3 *(n = 155)*	Co 4 *(n = 162)*	Co 5 *(n = 164)*	Co 6 *(n = 149)*	Co 7 *(n = 195)*	Co 8 *(n = 200)*	Co 9 *(n = 182)*	Co 10 *(n = 220)*
a	23	41	46	35	43	32	28	53	31	47
b	37	29	28	35	24	28	32	23	30	26
c	40	30	26	31	33	40	40	25	39	27

Table C-12
Summary of Company Means on Difficulty of AQ Versus CQ: % Soldiers

	AQ More Difficult	CQ More Difficult	Same Degree of Difficulty
Breakout by POI			
Current POI	38%	31%	32%
Legacy POI	38%	28%	34%
Breakout by Sequence			
CQ First	31%	32%	38%
AQ First	43%	28%	30%
All Companies			
Difficult	38%	29%	33%

9. Did firing one Qualification before the other Qualification increase your confidence that you could do well on either? (Check ✓ one)
[*Version of question for CQ first group: Did firing CQ before AQ increase your confidence that youwould do well on AQ?*
Version of question for AQ first group: Did firing AQ before CQ increase your confidence that you would do well on CQ?]

___ a. Yes, increased my confidence
___ b. Had no impact on my confidence
___ c. Made me unsure/uncertain regarding how well I would do

Table C-13
Individual and Summary Company Percentages on AQ Confidence When Shot CQ First

	CQ First – Current POI		CQ First – Legacy POI		All Co
	Co 1 *(n = 173)*	Co 2 *(n = 189)*	Co 6 *(n = 149)*	Co 7 *(n = 195)*	
a Increased confidence	59%	39%	64%	55%	54%
b No impact on confidence	28%	33%	26%	34%	30%
c Made unsure / uncertain	13%	29%	10%	11%	16%

Table C-14
Individual and Summary Company Percentages on CQ Confidence When Shot AQ First

	AQ First – Current POI			AQ First – Legacy POI			All Co
	Co 3 *(n = 155)*	Co 4 *(n = 162)*	Co 5 *(n = 164)*	Co 8 *(n = 200)*	Co 9 *(n = 182)*	Co 10 *(n = 220)*	
a Increased confidence	61%	77%	59%	60%	67%	66%	65%
b No impact on confidence	30%	15%	32%	30%	26%	25%	26%
c Made unsure / uncertain	8%	7%	9%	11%	7%	9%	9%

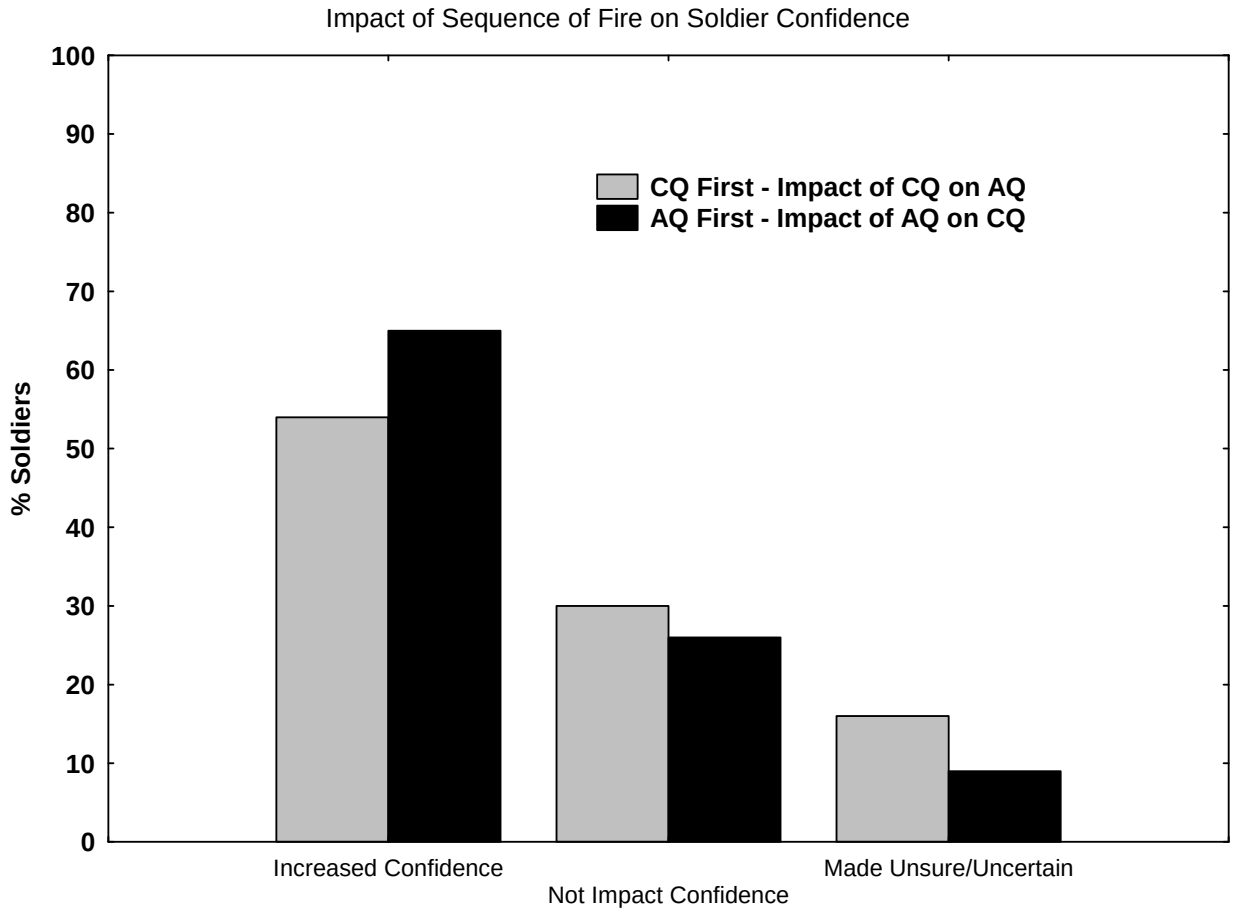

Figure C-3. Soldier responses on the extent to which the sequence of firing AQ and CQ affected their confidence.

Part II. Marksmanship Skills

In answering the questions in Part II, consider **ALL** the marksmanship training you received.

10. Which positions do you feel that you need ***more practice*** to establish a stable firing position? (Circle "Y" or "N" for each position)

Y N a. Prone (P)
Y N b. Kneeling (K)
Y N c. Barricade (B)

Table C-15
Individual Company Percentages on Needing More Practice in Achieving Stable Firing Positions

	Current POI										Legacy POI									
	CQ First				AQ First						CQ First				AQ First					
	Co 1 *(n = 167 - 172)*		Co 2 *(n = 188)*		Co 3 *(n = 155)*		Co 4[4] *(n = 158-163)*[5]		Co 5 *(n = 163 - 164)*		Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 199)*		Co 9 *(n = 182)*		Co 10 *(n = 220)*	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
P	9	91	22	78	21	79	52	48	7	93	26	74	23	77	26	74	14	86	18	82
K	73	27	54	46	61	39	46	54	70	30	62	38	58	42	54	46	57	43	58	42
B	27	73	39	61	32	68	32	68	23	77	33	67	39	61	36	64	32	68	36	64

11. Which positions were **difficult** for you **to learn**? (Circle "Y" or "N" for each position)

Table C-16
Individual Company Percentages on Difficulty in Learning Firing Positions

	Current POI										Legacy POI									
	CQ First				AQ First						CQ First				AQ First					
	Co 1 *(n = 166 – 171)*		Co 2 *(n = 185-188)*		Co 3 *(n = 155)*		Co 4 *(n = 157-163)*[6]		Co 5 *(n = 163 - 164)*		Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 199)*		Co 9 *(n = 182)*		Co 10 *(n = 219)*	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
P	4	96	15	85	14	86	40	60	4	96	17	83	11	89	11	89	7	93	16	84
K	54	46	45	55	50	50	39	61	46	54	52	48	49	51	58	42	39	61	36	64
B	22	78	28	72	14	86	17	83	9	91	24	76	27	73	12	89	14	86	19	81

[4] For questions 10-13, Co 4 was administered a survey that contained three choices for the prone position (prone supported with sandbags, prone supported with magazine, and prone unsupported (elbows only)). The numbers in each table reflect the total number of positive answers if any of the three choices were selected by the Soldiers.
[5] 5 Soldiers left the barricade (B) question blank.
[6] 6 Soldiers left the barricade (B) question blank.

Table C-17
Summary of Company Means on Needing Practice and Difficulty in Learning the Three Firing Positions: % Soldiers

	Prone	Kneeling	Barricade
Need More Practice			
Breakout by POI			
Current POI	22%	61%	31%
Legacy POI	21%	58%	35%
Breakout by Sequence			
CQ First	20%	62%	34%
AQ First	23%	58%	32%
All Companies			
	22%	59%	33%
Difficult to Learn			
Breakout by POI			
Current POI	15%	47%	18%
Legacy POI	12%	47%	19%
Breakout by Sequence			
CQ First	12%	50%	25%
AQ First	15%	45%	14%
All Companies			
	14%	47%	19%

Note. Soldiers could check more than one position.

12. Which position is the <u>most</u> comfortable firing position for you? (Check ✓ only **ONE** position)

_____ a. Prone (P)
_____ b. Kneeling (K)
_____ c. Barricade (B)

Table C-18
Individual Company Percentages on Which Firing Position was Most Comfortable

	Current POI					Legacy POI				
	CQ First		AQ First			CQ First		AQ First		
	Co 1 *(n = 173)*	Co 2 *(n = 189)*	Co 3 *(n = 155)*	Co 4 *(n = 163)*	C 5 *(n = 164)*	Co 6 *(n = 149)*	Co 7 *(n = 195)*	Co 8 *(n = 200)*	Co 9 *(n = 182)*	Co 10 *(n = 220)*
P	80	65	45	72	66	87	67	56	52	52
K	7	25	10	14	5	9	21	21	15	12
B	14	12	45	14	29	5	12	24	34	36

13. Which position is the <u>least</u> comfortable firing position for you? (Check ✓ only **ONE** position**)**

Table C-19
Individual Company Percentages on Which Firing Position was Least Comfortable

	Current POI					Legacy POI				
	CQ First		AQ First			CQ First		AQ First		
	Co 1 *(n = 173)*	Co 2 *(n = 189)*	Co 3 *(n = 155)*	Co 4 *(n = 163)*	Co 5 *(n = 164)*	Co 6 *(n = 149)*	Co 7 *(n = 195)*	Co 8 *(n = 200)*	Co 9 *(n = 182)*	Co 10 *(n = 220)*
P	5	13	21	43	6	13	16	17	16	21
K	78	59	71	52	87	72	63	69	70	60
B	17	28	8	7	7	15	21	14	14	19

Table C-20
Summary of Company Means on Which Firing Positions were Most Comfortable and Least Comfortable: Percent Soldiers

	Prone	Kneeling	Barricade
Most Comfortable			
Breakout by POI			
Current POI	66%	12%	23%
Legacy POI	63%	16%	22%
Breakout by Sequence			
CQ First	75%	15%	11%
AQ First	57%	13%	30%
All Companies			
	64%	14%	23%
Least Comfortable			
Breakout by POI			
Current POI	18%	69%	13%
Legacy POI	17%	67%	17%
Breakout by Sequence			
CQ First	12%	68%	20%
AQ First	21%	68%	12%
All Companies			
	17%	68%	15%

Note. Soldiers checked only one position.

Weapon Handling

14. For which of the following weapon handling procedures do you feel you need ***more practice*****?** (Circle "Y" or "N" for each procedure)

Y N a. Weapon maintenance procedures
Y N b. Performing a function check
Y N c. Preventing an accidental discharge from my weapon
Y N d. Rapidly changing magazines in different positions
Y N e. Quickly correcting a malfunction
Y N f. Proper weapon clearing procedures

Table C-21
Individual Company Percentages on Which Weapon Handling Procedures Needed More Practice

	Current POI										Legacy POI									
	CQ First				AQ First						CQ First				AQ First					
	Co 1 *(n = 173)*		Co 2 *(n = 189)*		Co 3 *(n = 155)*		Co 4 *(n = 162)*		Co 5 *(n = 164)*		Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 199)*		Co 9 *(n = 182)*		Co 10 *(n = 220)*	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
a	6	94	10	90	28	72	15	85	9	91	6	94	17	83	7	94	3	97	9	91
b	3	97	9	91	14	86	15	85	10	90	7	93	17	83	11	89	6	94	5	95
c	4	96	5	95	9	91	4	96	1	99	3	97	8	92	5	95	3	97	3	97
d	25	75	30	70	36	64	38	62	34	66	30	70	40	60	29	71	36	64	33	67
e	21	79	38	62	41	59	48	52	20	80	29	71	37	63	30	70	24	76	29	71
f	2	98	2	98	8	92	7	93	1	99	1	99	5	95	3	97	6	94	2	98

15. Which of the weapon handling procedures were **difficult to learn**?
(Circle "Y" or "N" for each procedure)

Table C-22
Individual Company Percentages on Which Weapon Handling Procedures Were Difficult to Learn

	Current POI										Legacy POI									
	CQ First				AQ First						CQ First				AQ First					
	Co 1 *(n = 172 – 173)*		Co 2 *(n = 183-189)*[7]		Co 3 *(n = 155)*		Co 4 *(n = 162)*		Co 5 *(n = 164)*		Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 198-200)*		Co 9 *(n = 182)*		Co 10 *(n = 213 - 220)*[8]	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
a	3	97	5	95	12	88	9	91	7	93	3	97	9	91	6	94	3	97	6	94
b	6	94	10	90	14	86	9	91	10	90	6	94	9	91	9	91	6	94	8	92
c	3	97	4	96	9	91	2	98	2	98	2	98	5	95	3	97	3	97	3	97
d	22	78	19	81	22	78	22	78	26	74	16	84	22	78	21	79	26	74	16	84
e	20	80	30	70	36	64	44	56	14	86	26	74	29	71	29	71	25	75	22	78
f	1	99	3	97	5	95	4	96	3	97	1	99	4	96	5	96	4	96	2	98

[7] 6 Soldiers left question "f" blank.
[8] 7 Soldiers left question "f" blank.

Table C-23
Summary of Company Means on Needing Practice and Difficulty in Learning Weapon Handling Procedures: Percent Soldiers

	Rapidly Change Magazine in Different Positions	Quickly Correct Malfunction	Function Check	Maintenance Procedures	Prevent Accidental Discharge	Weapon Clearing Procedures
Need More Practice						
Breakout by POI						
Current POI	33%	34%	10%	14%	5%	4%
Legacy POI	33%	30%	9%	8%	4%	3%
Breakout by Sequence						
CQ First	31%	31%	9%	9%	5%	3%
AQ First	34%	34%	10%	12%	5%	5%
All Companies						
	33%	29%	10%	11%	5%	4%
Difficult to Learn						
Breakout by POI						
Current POI	22%	29%	10%	7%	4%	3%
Legacy POI	20%	26%	8%	5%	3%	3%
Breakout by Sequence						
CQ First	20%	26%	8%	5%	4%	2%
AQ First	22%	28%	9%	7%	4%	4%
All Companies						
	22%	28%	9%	7%	4%	4%

Note. In general, the weapons handling procedures are ordered from high to low in terms of needing more practice and learning difficulty.

Basic Skills

16. For which of the following basic skills do you feel you need ***more practice*****?**
(Circle "Y" or "N" for each skill)

Y N	a.	Consistently getting tight shot groups
Y N	b.	Adjusting my iron sights to zero my weapon with no assistance
Y N	c.	Adjusting the M68 (CCO) to zero my weapon with no assistance
Y N	d.	Controlling my breathing so my weapon does not move when I fire
Y N	e.	Squeezing the trigger so my weapon does not move when I fire
Y N	f.	Maintaining the same sight picture each time I fire

Table C-24
Individual Company Percentages on Which Basic Skills Needed More Practice

	Current POI										Legacy POI									
	CQ First				AQ First						CQ First				AQ First					
	Co 1 *(n = 172 – 173)*		Co 2 *(n = 189)*		Co 3 *(n = 153-155)*		Co 4 *(n = 161)*		Co 5 *(n = 164)*		Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 200)*		Co 9 *(n = 182)*		Co 10 *(n = 217 – 220)*[9]	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
A	35	65	32	68	41	59	31	69	52	48	20	80	37	63	42	58	34	66	33	67
b	41	59	64	36	72	28	43	57	38	62	35	65	61	39	30	71	37	63	55	45
c	50	50	53	47	63	37	38	62	27	73	39	61	55	45	31	70	56	44	59	41
d	35	65	23	77	24	76	30	70	31	69	17	83	26	74	30	70	21	79	23	77
e	20	80	26	74	25	75	24	76	21	79	19	81	28	72	31	69	21	79	20	80
f	20	80	35	65	32	68	36	64	23	77	20	80	35	65	46	54	30	70	30	70

17. Which of the basic skills were **difficult to learn**? (Circle "Y" or "N" for each skill)

Table C-25
Individual Company Percentages on Which Basic Skills Were Difficult to Learn

	Current POI										Legacy POI									
	CQ First				AQ First						CQ First				AQ First					
	Co 1 *(n = 173)*		Co 2 *(n = 183-189)*[10]		Co 3 *(n = 155)*		Co 4 *(n = 162)*		Co 5 *(n = 163 - 164)*		Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 200)*		Co 9 *(n = 178-182)*[11]		Co 10 *(n = 215 – 220)*[12]*C*	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
a	24	76	18	82	36	64	31	69	30	70	19	81	25	75	43	58	23	77	30	70
b	34	66	47	53	59	41	33	67	32	68	19	81	50	50	23	78	29	71	35	65
c	39	61	43	57	53	47	28	72	20	80	26	74	45	55	21	79	41	59	33	67
d	24	76	21	79	17	83	24	76	20	80	13	87	21	79	24	76	21	79	17	83
e	21	79	28	72	19	81	27	73	15	85	12	88	23	77	29	72	18	82	20	80
f	21	79	37	63	34	66	36	64	22	78	17	83	37	63	46	55	30	70	34	66

[9] 3 Soldiers left question "c" blank.
[10] 6 Soldiers left question "c" blank.
[11] 4 Soldiers left question "b" blank.
[12] 5 Soldiers left question "c" blank.

Table C-26

Summary of Company Means on Needing Practice and Difficulty in Learning Basic Skills: Percent Soldiers

	Adjust Iron Sights to Zero Weapon wo/ Assistance	Adjust M68 to Zero Weapon wo/ Assistance	Consistently get Tight Shot Groups	Maintain Same Sight Picture Each Time I Fire	Control Breathing so Weapon Does not Move When I Fire	Squeeze Trigger so Weapon Does Not Move When I Fire
Need More Practice						
Breakout by POI						
Current POI	52%	46%	38%	29%	29%	23%
Legacy POI	44%	48%	33%	32%	23%	24%
Breakout by Sequence						
CQ First	50%	49%	31%	28%	25%	23%
AQ First	46%	46%	39%	33%	27%	24%
All Companies						
	48%	47%	36%	31%	26%	24%
Difficult to Learn						
Breakout by POI						
Current POI	41%	37%	28%	30%	21%	22%
Legacy POI	31%	33%	28%	33%	19%	20%
Breakout by Sequence						
CQ First	38%	38%	22%	28%	20%	21%
AQ First	39%	39%	33%	35%	21%	22%
All Companies						
	36%	35%	28%	31%	20%	21%

Note. In general, the basic skills are ordered from high to low in terms of needing more practice and learning difficulty.

Target Engagement

18. For which of the following skills do you feel you need ***more practice*****?**
(Circle "Y" or "N" for each skill.)

Y N a. Hitting targets at 250 and 300 meters
Y N b. Hitting multiple targets at different distances that are exposed at the same time
Y N c. Adjusting my point of aim to hit targets

Table C-27
Individual Company Percentages on Which Target Engagement Skills Needed More Practice

	Current POI										Legacy POI									
	CQ First				AQ First						CQ First				AQ First					
	Co 1 *(n = 173)*		Co 2 *(n = 189)*		Co 3 *(n = 155)*		Co 4 *(n = 161-163)*		Co 5 *(n = 163-164)*		Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 200)*		Co 9 *(n = 182)*		Co 10 *(n = 220)*	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
a	68	32	69	31	79	21	80	20	57	43	52	48	68	32	78	22	62	38	71	29
b	17	83	41	59	28	72	32	68	26	74	21	79	32	68	32	69	24	76	24	76
c	23	77	43	57	32	68	29	71	26	74	19	81	35	65	32	68	28	72	30	70

19. Which of the following skills were **difficult to learn**? (Circle "Y" or "N" for each skill.)

Table C-28
Individual Company Percentages on Which Target Engagement Skills Were Difficult to Learn

	Current POI										Legacy POI									
	Group A CQ First				Group B AQ First						Group C CQ First				Group D AQ First					
	Co 1 *(n = 173)*		Co 2 *(n = 189)*		Co 3 *(n = 155)*		Co 4 *(n = 162-163)*		Co 5 *(n = 164)*		Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 200)*		Co 9 *(n = 182)*		Co 10 *(n = 220)*	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
a	43	57	47	53	60	40	59	41	28	72	38	62	50	50	59	42	40	60	45	55
b	14	86	26	74	16	84	21	79	14	86	17	83	24	76	28	73	19	81	17	83
c	20	80	34	66	20	80	27	73	15	85	15	85	32	68	28	72	20	80	30	70

Table C-29
Summary of Company Means on Needing Practice and Difficulty in Learning Target Engagement Skills: Percent Soldiers

	Hitting Targets at 250 and 300 Meters	Adjusting Point of Aim to Hit Targets	Hitting Multiple Targets at Different Distances That are Exposed At Same Time
Need More Practice			
Breakout by POI			
Current POI	71%	31%	29%
Legacy POI	66%	29%	27%
Breakout by Sequence			
CQ First	64%	30%	28%
AQ First	71%	30%	28%
All Companies			
	68%	30%	28%
Difficult to Learn			
Breakout by POI			
Current POI	47%	23%	18%
Legacy POI	46%	25%	21%
Breakout by Sequence			
CQ First	45%	25%	20%
AQ First	49%	23%	19%
All Companies			
	47%	24%	20%

Note. Soldiers could check more than one skill. Results are ordered from high to low.

Part III. Change in Skills

20. Was there a point (an event or time) in marksmanship training (BRM through ARM) **where you became very confident** about handling and shooting your weapon under many conditions?
[*We're referring to a point where"things really clicked" for you or when your training "suddenly made more sense to you."]*

a. Yes
b. No --- still somewhat unsure about some aspects of shooting and handling my weapon
c. No change --- confident of my weapon skills at the start

Table C-30
Individual Company Percentages on the Stage in Marksmanship Training Where Soldier Became Very Confident in Handling and Shooting Weapon

	Current POI					Legacy POI				
	CQ First		AQ First			CQ First		AQ First		
	Co 1 *(n = 173)*	Co 2 *(n = 189)*	Co 3 *(n = 155)*	Co 4 *(n = 163)*	Co 5 *(n = 164)*	Co 6 *(n = 149)*	Co 7 *(n = 195)*	Co 8 *(n = 200)*	Co 9 *(n = 182)*	Co 10 *(n = 220)*
a	66%	71%	65%	69%	68%	67%	66%	65%	62%	60%
b	6%	10%	13%	12%	6%	8%	14%	8%	12%	13%
c	28%	20%	22%	19%	26%	25%	21%	28%	26%	26%

Overall Percentages for "yes" responses were:

Current POI: 68% Legacy POI: 64%

CQ First: 68% AQ First: 65%

Table C-31
Soldier Responses to Stage of Marksmanship Training Where They Became Very Confident: Percent Soldiers

Comment Category	CQ First		AQ First	
	Current POI (n = 214)	Legacy POI (n = 194)	Current POI (n = 321)	Legacy POI (n = 367)
Practice Qualification for Army Qualification	21%	18%	20%	20%
Army Qualification	9%	9%	27%	31%
Combat Qualification	22%	22%	9%	9%
Training on Fundamentals	7%	6%	4%	4%
Grouping & Zeroing	10%	10%	8%	9%
LOMAH	5%	---	---	---
Advanced Rifle Marksmanship	---	---	5%	3%
When had More Practice	---	14%	6%	---
Drill Sergeant Influence	---	---	---	3%
Other	27%	21%	22%	20%

Note. LOMAH stands for Location of Misses and Hits. N refers to the number of comments

Question 21. Check your level of skill when you **started** marksmanship training.

Question 22. Check your level of skill **now (today**).

	Low or minimal level of skill, need much more practice									High level of skill, can't get much better
	1	2	3	4	5	6	7	8	9	10
21. Start of training (check 1 box)	□	□	□	□	□	□	□	□	□	□
22. Now (check 1 box)	□	□	□	□	□	□	□	□	□	□

Table C-32
Current Strategy: Individual Company Ratings on Level of Skill at the Start (S) and End (N) of Training (Percent Soldiers)

Skill Level (1 = low, 10 = high)	CQ First				AQ First					
	Co 1 *(n = 173)*		Co 2 *(n = 189)*		Co 3 *(n = 155)*		Co 4 *(n = 163)*		Co 5 *(n = 164)*	
	S	N	S	N	S	N	S	N	S	N
1	20%	1%	32%	1%	24%	0%	23%	0%	15%	0%
2	9%	0%	8%	1%	8%	0%	14%	0%	9%	0%
3	16%	2%	18%	0%	21%	0%	14%	2%	15%	0%
4	11%	3%	10%	2%	12%	2%	17%	4%	13%	1%
5	10%	4%	10%	7%	13%	9%	12%	10%	18%	3%
6	11%	10%	9%	18%	8%	10%	10%	20%	9%	6%
7	12%	22%	7%	35%	7%	27%	5%	26%	10%	23%
8	6%	25%	3%	28%	6%	35%	4%	26%	7%	40%
9	3%	26%	2%	6%	1%	14%	1%	10%	4%	21%
10	2%	6%	1%	2%	0%	2%	0%	2%	1%	6%
Mean	4.24	7.57	3.44	7.02	3.75	7.35	3.57	6.93	4.40	7.86
StdDev	2.50	1.62	2.36	1.31	2.26	1.27	2.11	1.45	2.35	1.13

Table C-33
Current Strategy: Individual Company Ratings on Level of Skill at the Start (S) and End (N) of Training (Percent Soldiers)

Skill Level (1 = low, 10 = high)	CQ First				AQ First					
	Co 6 *(n = 149)*		Co 7 *(n = 195)*		Co 8 *(n = 200)*		Co 9 *(n = 182)*		Co 10 *(n = 220)*	
	S	N	S	N	S	N	S	N	S	N
1	30%	0%	24%	0%	24%	0%	16%	0%	28%	0%
2	8%	0%	11%	1%	12%	1%	14%	0%	9%	0%
3	9%	0%	16%	0%	17%	0%	8%	0%	14%	1%
4	7%	1%	15%	1%	10%	2%	12%	2%	14%	2%
5	17%	5%	11%	10%	11%	10%	13%	7%	11%	10%
6	8%	9%	12%	17%	12%	13%	13%	6%	12%	13%
7	10%	27%	6%	32%	13%	27%	13%	29%	7%	24%
8	9%	30%	3%	25%	1%	27%	7%	33%	4%	31%
9	2%	23%	1%	13%	2%	18%	2%	17%	1%	16%
10	0%	5%	1%	3%	1%	3%	2%	7%	0%	5%
Mean	3.97	7.73	3.60	7.16	3.74	7.31	4.37	7.63	3.62	7.35
StdDev	2.55	1.24	2.16	1.31	2.27	1.42	2.44	1.30	2.24	1.43

Table C-34

Summary of Company Means on Level of Skill at the Start (S) and End (N) of Training: Percent Soldiers

Skill Level 1 = low 10 = high	Breakout by POI				Breakout by Sequence			
	Current POI		Legacy POI		CQ First		AQ First	
	S	N	S	N	S	N	S	N
1	22.8%	0.4%	24.4%	0.0%	26.5%	0.5%	21.7%	0.2%
2	9.8%	0.2%	10.8%	0.4%	9.0%	0.5%	11.0%	0.2%
3	16.8%	0.8%	12.8%	0.2%	14.8%	0.5%	14.8%	1.3%
4	12.6%	2.4%	11.6%	1.6%	10.8%	1.8%	13.0%	5.7%
5	12.6%	6.6%	12.6%	8.4%	12.0%	6.5%	13.0%	9.0%
6	9.4%	12.8%	11.4%	11.6%	10.0%	13.5%	10.7%	19.3%
7	8.2%	26.6%	9.8%	27.8%	8.8%	29.0%	9.2%	27.8%
8	5.2%	30.8%	4.8%	29.2%	5.3%	27.0%	4.8%	25.3%
9	2.2%	15.4%	1.6%	17.4%	2%	16.0%	1.8%	10.0%
10	0.8%	3.6%	0.8%	4.6%	1%	4.0%	0.7%	3.3%

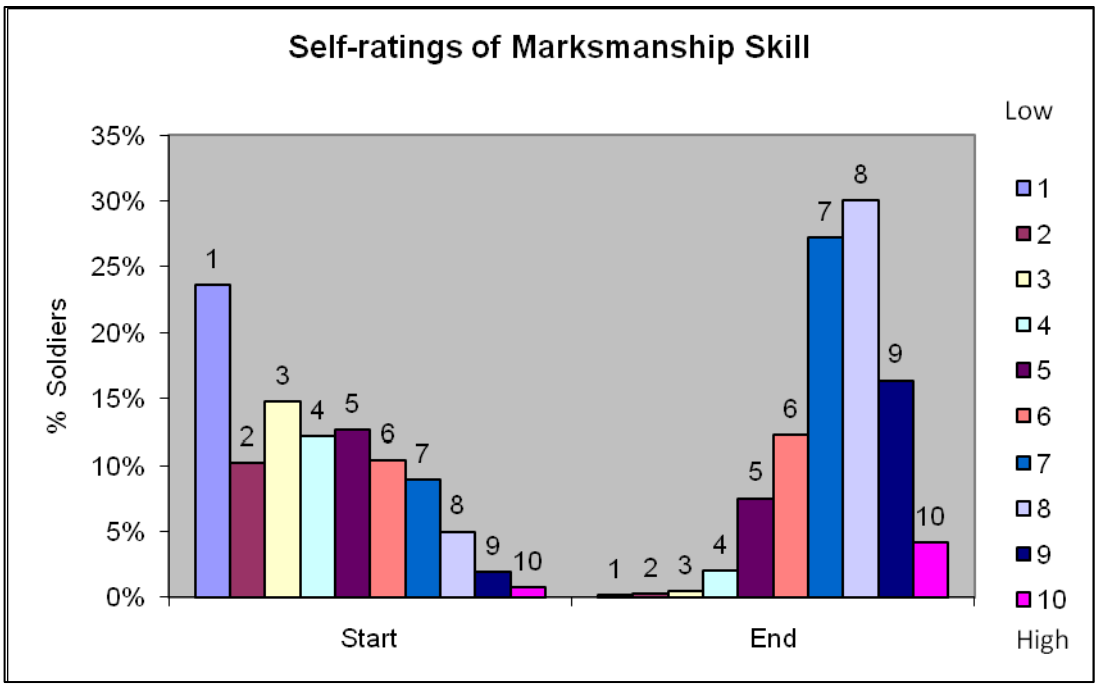

Figure C-4. Soldier self-ratings of their level of marksmanship skill at the start and end of training. [Percentages based on individual responses not company means.]

Appendix D

Company Commander Input Form

Company _____

1. If you have the marksmanship records for the company that preceded the company in the Marksmanship study, in the table below please provide the marksmanship results for that company.

Number (#) and percentage (%) of Soldiers in each marksmanship category.

Marksmanship Category	**# of Soldiers in prior Company**	**% of Soldiers in prior Company**
Expert		
Sharpshooter		
Marksman		
Unqualified		

2. Did the Soldiers in the company in the Marksmanship study have similar backgrounds to those in the immediately preceding company (e.g., proportion in National Guard vs. Active Army, from same parts of the US, MOS, computer skills, age, etc.)?

Put an X before the Yes or No below.

___ Yes
___ No

If "No," briefly indicate the primary ways they differed.

_____

_____

_____

_____

_____

_____

_____

_____

3. How was marksmanship training conducted for the company in the Marksmanship study? Check (X) one

____ By individual platoons

____ Company Round Robin
If Company Round Robin was used, on what basis did you select the key trainer(s)?

____ Other - Please describe.

4. Are there any other factors that you think could have impacted the results for your company (e.g., was platoon competition encouraged)? Please describe.

4. Lastly, we want to document the background of the cadre in your company which participated in the Marksmanship study. Please complete the table below.

We are **NOT** asking for individual names. The table simply assigns an arbitrary number to each Drill Sergeant. If you only had ten DSs during the Marksmanship study period, then you would only indicate the background for ten Drill Sergeants (that is, DS1 through DS 10).

Position held during Marksmanship study	**Experience in Position** If the "Marksmanship Company" was FIRST TIME an individual served in the duty position, put an "X" after "Yes"" If the "Marksmanship Company" was NOT THE FIRST TIME in the duty position, indicate the # of prior company training cycles where the individual held this position (e.g., a DS)	**MOS / Branch**	**Rank**	**List any special marksmanship training your 1SG or a DS has had.** Examples: --Sniper School --Squad Designated Marksman (SDM) --CART-C (AWG, CATC) --Special Operations Target Interdiction Course (SOTIC)
Company Commander	First time? Yes ___ # prior cycles ____			
1SG Does your 1SG have prior experience as a DS? Yes ____ No ____	First time? Yes ___ # prior cycles ____			
DS1	First time? Yes ___ # prior cycles ____			
DS2	First time? Yes ___ # prior cycles ____			
DS3	First time? Yes ___ # prior cycles ____			
DS4	First time? Yes ___ # prior cycles ____			

Position held during Marksmanship study	**Experience in Position** If the "Marksmanship Company" was FIRST TIME an individual served in the duty position, put an "X" after "Yes"" If the "Marksmanship Company" was NOT THE FIRST TIME in the duty position, indicate the # of prior company training cycles where the individual held this position (e.g., a DS)	**MOS / Branch**	**Rank**	**List any special marksmanship training your 1SG or a DS has had.** Examples: --Sniper School --Squad Designated Marksman (SDM) --CART-C (AWG, CATC) --Special Operations Target Interdiction Course (SOTIC)
DS5	First time? Yes ___ # prior cycles ____			
DS6	First time? Yes ___ # prior cycles ____			
DS7	First time? Yes ___ # prior cycles ____			
DS8	First time? Yes ___ # prior cycles ____			
DS9	First time? Yes ___ # prior cycles ____			
DS10	First time? Yes ___ # prior cycles ____			
DS11	First time? Yes ___ # prior cycles ____			
DS12	First time? Yes ___ # prior cycles ____			

Appendix E
CFF Codes by Target for Kills and No Kills

Kneeling 50mL, 2 exposures, Firing Table 1-1										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
2hits only	815	63.1%	87	68.0%	236	68.2%	348	64.6%	130	51.8%
2 hits w misses										
2hit 1miss	132	10.2%	5	3.9%	27	7.8%	58	10.8%	37	14.7%
2hit >1miss	26	2.0%	3	2.3%	5	1.4%	12	2.2%	6	2.4%
2 hits w malf	187	14.5%	28	21.9%	51	14.7%	75	13.9%	31	12.4%
2 hits w magch										
Magch combo										
2hit 1miss magch	1	0.1%					1	0.2%		
Hit miss malf combo										
2hit 1miss 1malf	60	4.6%	3	2.3%	18	5.2%	20	3.7%	17	6.8%
2hit >1miss 1malf	14	1.1%	1	0.8%	4	1.2%	3	0.6%	5	2.0%
Other (dm)	*56*	*4.3%*	*1*	*0.8%*	*5*	*1.4%*	*22*	*4.1%*	*25*	*10.0%*
sum	**1291**	**1**	**128**	**1**	**346**	**1**	**539**	**1**	**251**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Misses only	23	10.8%			3	14.3%	3	4.8%	17	13.5%
1hit w misses										
1hit 1miss	47	22.2%			5	23.8%	13	21.0%	28	22.2%
1hit >1miss	15	7.1%			3	14.3%	7	11.3%	5	4.0%
Miss w malf										
>1miss w malf	4	1.9%							4	3.2%
Miss with magch										
NF only & NF comb										
2nf	21	9.9%			1	4.8%	3	4.8%	17	13.5%
1hit 1nf	51	24.1%	1	100.0%	5	23.8%	16	25.8%	27	21.4%
1hit 1malf 1nf	6	2.8%					4	6.5%	4	3.2%
1miss 1malf 1nf	2	0.9%							1	0.8%
1miss 1nf	11	5.2%			1	4.8%	4	6.5%	6	4.8%
Hit miss malf combo										
1hit 1miss 1malf	13	6.1%			2	9.5%	5	8.1%	6	4.8%

1hit >1miss 1malf	10	4.7%					7	11.3%	3	2.4%
Other (dm)	*9*	*4.2%*			*1*	*4.8%*			*8*	*6.3%*
sum	**212**	**1**	**1**	**1**	**21**	**1**	**62**	**1**	**126**	**1**
Kneeling 50m R, 2 exposures, Firing Table 1-2										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
2hits only	846	69.3%	93	74.4%	247	71.8%	353	70.2%	139	62.6%
2hits w misses										
2hit 1miss	117	9.6%	11	8.8%	33	9.6%	44	8.7%	25	11.3%
2hit >1miss	17	1.4%	1	0.8%	1	0.3%	10	2.0%	5	2.3%
2hits with malf	132	10.8%	14	11.2%	39	11.3%	46	9.1%	29	13.1%
2hits with magch	2	0.2%			1	0.3%				
Magch combo										
2hit 3miss magch	1	0.1%					1	0.2%		
Hit miss malf combo										
2hit 1miss 1malf	47	3.9%	2	1.6%	11	3.2%	23	4.6%	9	4.1%
2hit >1miss 1malf	11	0.9%					8	1.6%	3	1.4%
Other (dm)	*47*	*3.9%*	*4*	*3.2%*	*12*	*3.5%*	*18*	*3.6%*	*12*	*5.4%*
sum	**1220**	**1**	**125**	**1**	**344**	**1**	**503**	**1**	**222**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Misses only	73	25.8%			11	50.0%	24	24.5%	38	24.7%
<2hits w misses										
1hit 1miss	44	15.5%	2	50.0%	2	9.1%	22	22.4%	18	11.7%
1hit >1miss	16	5.7%			1	4.5%	6	6.1%	9	5.8%
<=1hit w malf								0.0%		
>1miss 1malf	17	6.0%					7	7.1%	10	6.5%
1hit w magch										
Magch combo										
NF only & NF combo										
2nf	23	8.1%					7	7.1%	14	9.1%
1hit 1nf	54	19.1%			4	18.2%	15	15.3%	33	21.4%
1hit 1malf 1nf	3	1.1%	1	25.0%	1	4.5%			2	1.3%
1miss 1nf	20	7.1%			1	4.5%	4	4.1%	12	7.8%
1miss 1malf 1nf	3	1.1%					2	2.0%	1	0.6%
1malf 2nf	1	0.4%							1	0.6%
Hit miss malf combo										
1hit 1miss 1malf	10	3.5%			1	4.5%	5	5.1%	4	2.6%

1hit >1miss 1malf	9	3.2%	1	25.0%			4	4.1%	4	2.6%
Other (dm)	10	*3.5%*			*1*	*4.5%*	*2*	*2.0%*	*8*	*5.2%*
sum	**283**	**1**	**4**	**1**	**22**	**1**	**98**	**1**	**154**	**1**
Kneeling 100m 1 exposure, Firing Table 1-3										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
1hit only	696	54.1%	80	64.0%	198	55.6%	297	56.4%	104	42.1%
1 hit w misses										
1hit 1miss	254	19.8%	17	13.6%	59	16.6%	110	20.9%	61	24.7%
1hit >1miss	102	7.9%	7	5.6%	23	6.5%	38	7.2%	33	13.4%
1hit with malf	73	5.7%	11	8.8%	26	7.3%	22	4.2%	13	5.3%
1hit with magch	2	0.2%			1	0.3%	0		1	0.4%
Magch combo										
1hit <1miss 1malf magch	2	0.2%					2	0.4%		
Hit miss malf combo										
1hit 1miss 1malf	72	5.6%	5	4.0%	23	6.5%	32	6.1%	10	4.0%
1hit >1miss 1malf	69	5.4%	4	3.2%	21	5.9%	20	3.8%	22	8.9%
Other (dm)	*16*	*1.2%*	*1*	*0.8%*	*5*	*1.4%*	*6*	*1.1%*	*3*	*1.2%*
sum	**1286**	**1**	**125**	**1**	**356**	**1**	**527**	**1**	**247**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Misses only										
1miss	33	15.3%			2	20.0%	12	16.2%	19	14.7%
>1miss	110	51.2%	1	50.0%	6	60.0%	36	48.6%	67	51.9%
Misses with malf										
1miss 1malf	6	2.8%					1	1.4%	5	3.9%
>1miss 1malf	37	17.2%			1	10.0%	16	21.6%	20	15.5%
Miss with magch	1	0.5%			1	10.0%				
>1miss magch	3	1.4%					1	1.4%	2	1.6%
NF only & NF combo										
1nf	25	11.6%	1	50.0%			8	10.8%	16	12.4%
Hit miss malf combo										
Other (dm)										
sum	**215**	**1**	**2**	**1**	**10**	**1**	**74**	**1**	**129**	**1**
Kneeling 150m 2 exposures, Firing Table 1-4										

Kills	Total		EX		SS		MM		UQ	
2hits only	359	32.6%	55	44.0%	107	32.4%	134	29.6%	55	32.2%
2hits w misses										
2hit 1miss	216	19.6%	27	21.6%	59	17.9%	86	19.0%	38	22.2%
2hit >1miss	97	8.8%	4	3.2%	36	10.9%	40	8.8%	15	8.8%
2hits with malf	120	10.9%	16	12.8%	35	10.6%	59	13.1%	9	5.3%
2hits with magch	3	0.3%			1	0.3%	1	0.2%	1	0.6%
Magch combo										
2hit 1miss magch	5	0.5%					5	1.1%		
2hit >1miss magch	38	3.5%	1	0.8%	12	3.6%	15	3.3%	7	4.1%
2hit >1miss 1malf magch	11	1.0%	5	4.0%	3	0.9%	6	1.3%	1	0.6%
Hit miss malf combo										
2hit 1miss 1malf	100	9.1%	11	8.8%	40	12.1%	38	8.4%	8	4.7%
2hit >1miss 1malf	74	6.7%			14	4.2%	33	7.3%	22	12.9%
Other (dm)	*77*	*7.0%*	*6*	*4.8%*	*23*	*7.0%*	*35*	*7.7%*	*15*	*8.8%*
sum	**1100**	**1**	**125**	**1**	**330**	**1**	**452**	**1**	**171**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
All misses	55	13.7%			2	5.6%	12	8.1%	40	19.5%
1hit with misses										
1hit 1miss	41	10.2%	1	25.0%	5	13.9%	15	10.1%	19	9.3%
1hit >1miss	81	20.1%	2	50.0%	10	27.8%	36	24.2%	30	14.6%
Miss with malf										
>1miss 1malf	33	8.2%			2	5.6%	12	8.1%	19	9.3%
Miss with magch										
>1m 1magch	6	1.5%	1	25.0%			1	0.7%	4	2.0%
Magch combo										
1hit >=1miss magch	25	6.2%			3	8.3%	10	6.7%	12	5.9%
>1miss 1malf 1magch	1	0.2%							1	0.5%
1hit >1miss 1malf magch	6	1.5%			2	5.6%	2	1.3%	2	1.0%
NF only & NF combo										
1hit 1nf	8	2.0%			1	2.8%	3	2.0%	4	2.0%
2nf	29	7.2%			3	8.3%	7	4.7%	19	9.3%
1miss 1nf	20	5.0%			3	8.3%	6	4.0%	11	5.4%
1miss magch 1nf	2	0.5%			1	2.8%			1	0.5%
1miss 1malf magch 1nf	1	0.2%					1	0.7%		
1hit 1magch 1nf	2	0.5%					2	1.3%		
1hit 1malf 1nf	5	1.2%					2	1.3%	3	1.5%
1miss 1malf 1nf	6	1.5%					1	0.7%	5	2.4%

Hit miss malf combo									
1hit 1miss 1malf	6	1.5%				2	1.3%	4	2.0%
1hit >1miss 1malf	68	16.9%			3	8.3%	34	22.8%	28	13.7%
Other (dm)	*7*	*1.7%*			*1*	2.8%	*3*	2.0%	*3*	1.5%
sum	**402**	**1**	**4**	**1**	**36**	**1**	**149**	**1**	**205**	**1**
Barricade 50m 3 exposures, Firing Table 2-1									
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
3hits only	106	15.2%	21	21.4%	30	13.9%	37	13.6%	17	17.7%
3hits w misses						0.0%				
3hit 1miss	8	1.1%			3	1.4%	4	1.5%	1	1.0%
3hit >1miss										
3hits with malf	52	7.5%	6	6.1%	17	7.9%	17	6.3%	12	12.5%
3hits with magch	355	51.0%	55	56.1%	115	53.2%	135	49.6%	41	42.7%
Magch combo										
3hit 1malf magch	78	11.2%	6	6.1%	27	12.5%	30	11.0%	11	11.5%
3hit 1miss magch	40	5.7%	3	3.1%	5	2.3%	26	9.6%	5	5.2%
3hit >1miss magch	5	0.7%	1	1.0%	1	0.5%	1	0.4%	2	2.1%
3hit 1miss 1malf magch	13	1.9%	1	1.0%	2	0.9%	8	2.9%	2	2.1%
3hit >1miss 1malf magch	2	0.3%			1	0.5%			1	1.0%
Hit miss malf combo										
3hit 1miss 1malf	5	0.7%			1	0.5%	3	1.1%	1	1.0%
3hit >1miss 1malf	2	0.3%					1	0.4%	1	1.0%
Other (dm)	*30*	*4.3%*	*5*	5.1%	*14*	6.5%	*10*	3.7%	*2*	2.1%
sum	**696**	**1**	**98**	**1**	**216**	**1**	**272**	**1**	**96**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
All misses only										
3 misses	6	0.7%					1	0.3%	5	1.8%
<3hits w misses										
2hit 1miss	20	2.5%			5	3.3%	9	2.7%	6	2.1%
2hit >1miss	1	0.1%							1	0.4%
1hit >1miss	7	0.9%					3	0.9%	4	1.4%
Miss w malf										
Miss with magch										
3miss magch	1	0.1%							1	0.4%
Magch combo										
2hit 1miss magch	76	9.4%	5	16.1%	17	11.3%	33	10.0%	20	7.1%

1hit >1miss magch	18	2.2%					7	2.1%	11	3.9%
2hit >1miss magch	11	1.4%			2	1.3%	6	1.8%	3	1.1%
2hit 1miss 1malf magch	20	2.5%	1	3.2%	3	2.0%	12	3.6%	3	1.1%
2hit >1miss 1malf magch	4	0.5%					2	0.6%	2	0.7%
1hit >1miss 1malf magch	7	0.9%					4	1.2%	3	1.1%
>=3miss 1malf magch	3	0.4%							3	1.1%
NF only & NF combo										
3nf	36	4.5%			2	1.3%	6	1.8%	27	9.6%
1malf 3nf	1	0.1%							1	0.4%
2hit magch 1nf	165	20.5%	12	38.7%	43	28.7%	68	20.7%	37	13.2%
2hit 1nf	95	11.8%	5	16.1%	24	16.0%	41	12.5%	22	7.9%
2hit 1malf 1nf	61	7.6%	4	12.9%	11	7.3%	30	9.1%	14	5.0%
2hit 1malf magch 1nf	37	4.6%	3	9.7%	9	6.0%	13	4.0%	12	4.3%
2hit 1miss magch 1nf	1	0.1%							1	0.4%
1hit 1miss 1nf	21	2.6%	1	3.2%	5	3.3%	8	2.4%	7	2.5%
1hit 1miss magch 1nf	28	3.5%			2	1.3%	9	2.7%	17	6.1%
1hit 2nf	82	10.2%			13	8.7%	36	10.9%	31	11.1%
1hit 1miss 1malf magch 1nf	3	0.4%					1	0.3%	2	0.7%
1hit 1magch 2nf	21	2.6%			3	2.0%	9	2.7%	9	3.2%
1hit 1miss 1malf 1nf	11	1.4%			1	0.7%	3	0.9%	7	2.5%
1hit 1malf 2nf	21	2.6%			2	1.3%	10	3.0%	8	2.9%
1hit 1malf magch 2nf	4	0.5%			1	0.7%	3	0.9%		
1miss 1malf 2nf	2	0.2%							2	0.7%
1miss 2nf	4	0.5%					3	0.9%	1	0.4%
2miss 1nf	2	0.2%			1	0.7%			1	0.4%
2miss 1malf magch 1nf	2	0.2%			1	0.7%			1	0.4%
2miss 1malf 1nf	1	0.1%					1	0.3%		
Hit, miss malf combo										
2hit 1miss 1malf	13	1.6%			1	0.7%	4	1.2%	6	2.1%
2hit >1miss 1malf	3	0.4%					2	0.6%	1	0.4%
1hit >1miss 1malf	6	0.7%					1	0.3%	7	2.5%
Other (dm)	*11*	*1.4%*			*4*	2.7%	*4*	1.2%	*4*	1.4%
sum	**805**	**1**	**31**	**1**	**150**	**1**	**329**	**1**	**280**	**1**
Barricade 100m (1st) 2 exposures, Firing Table 2-2										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
2hit only	355	37.6%	50	40.3%	126	42.0%	142	37.8%	29	23.8%
2hits w misses										

2hit 1miss	171	18.1%	22	17.7%	47	15.7%	74	19.7%	26	21.3%
2hit >1miss	65	6.9%	1	0.8%	19	6.3%	30	8.0%	12	9.8%
2hits with malf	60	6.3%	12	9.7%	19	6.3%	19	5.1%	9	7.4%
2hits with magch	96	10.2%	18	14.5%	31	10.3%	29	7.7%	16	13.1%
Magch combo										
2hit 1miss magch	41	4.3%	6	4.8%	13	4.3%	14	3.7%	7	5.7%
2hit >1miss magch	24	2.5%	1	0.8%	8	2.7%	13	3.5%	2	1.6%
2hit 1malf magch	6	0.6%	1	0.8%	3	1.0%	1	0.3%		
2hit 1miss 1malf magch	5	0.5%			1	0.3%	4	1.1%		
2hit >1miss 1malf magch	7	0.7%	1	0.8%	4	1.3%	2	0.5%		
Hit miss malf combo										
2hit 1miss 1malf	49	5.2%	6	4.8%	12	4.0%	21	5.6%	10	8.2%
2hit >1miss 1malf	41	4.3%	3	2.4%	11	3.7%	14	3.7%	9	7.4%
Other (dm)	*25*	*2.6%*	*3*	*2.4%*	*6*	2.0%	*13*	3.5%	*2*	1.6%
sum	**945**	**1**	**124**	**1**	**300**	**1**	**376**	**1**	**122**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Misses only	92	16.5%	1	20.0%	11	16.7%	33	14.7%	47	18.5%
<2hits w misses										
1hit 1miss	38	6.8%			6	9.1%	22	9.8%	10	3.9%
1hit >1miss	80	14.4%			8	12.1%	39	17.3%	32	12.6%
Miss w malf										
>=2miss 1malf	46	8.3%	1	20.0%	5	7.6%	17	7.6%	23	9.1%
Miss with magch										
>=2miss magch	33	5.9%			5	7.6%	4	1.8%	24	9.4%
Magch combo										
1hit 1miss magch	22	3.9%			1	1.5%	11	4.9%	9	3.5%
1hit >1miss magch	40	7.2%	1	20.0%	6	9.1%	20	8.9%	11	4.3%
1hit 1miss 1malf	1	0.2%								
>=2miss 1malf magch	10	1.8%			1	1.5%	1	0.4%	7	2.8%
1hit 1miss 1malf magch	8	1.4%			1	1.5%	3	1.3%	4	1.6%
1hit >1miss 1malf magch	9	1.6%			3	4.5%	5	2.2%	2	0.8%
NF only & NF combo										
2nf	30	5.4%			1	1.5%	7	3.1%	22	8.7%
1hit 1nf	21	3.8%	1	20.0%	5	7.6%	8	3.6%	6	2.4%
1hit magch 1nf	8	1.4%			1	1.5%	4	1.8%	3	1.2%
1hit 1malf magch 1nf	3	0.5%	1	20.0%			1	0.4%	1	0.4%
1hit 1malf 1nf	11	2.0%			3	4.5%	3	1.3%	5	2.0%
1miss 1nf	15	2.7%					6	2.7%	7	2.8%

1miss magch 1nf	11	2.0%			3	1.3%	8	3.1%
1miss 1malf magch 1nf	2	0.4%			1	0.4%	1	0.4%
1miss 1malf 1nf	6	1.1%			4	1.8%	2	0.8%
magch 2nf	1	0.2%					1	0.4%
Hit miss malf combo								
1hit 1miss 1malf	17	3.1%		4	6.1%	9	4.0%	5	2.0%
1hit >1miss 1malf	50	9.0%		5	7.6%	23	10.2%	22	8.7%
Other (dm)	*3*	*0.5%*				*1*	0.4%	*2*	0.8%
sum	**557**	**1**	**5**	**1**	**66**	**1**	**225**	**1**	**254**	**1**

Barricade 100m(2nd) 1 exposure, Firing Table 2-3

Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
1 hit only	651	58.7%	82	66.7%	211	64.1%	258	56.2%	93	52.2%
1hit w misses										
1 hit 1 miss	161	14.5%	18	14.6%	38	11.6%	76	16.6%	23	12.9%
1 hit >1 miss	56	5.0%	2	1.6%	12	3.6%	27	5.9%	14	7.9%
1hit with malf	109	9.8%	11	8.9%	37	11.2%	40	8.7%	19	10.7%
1hit with magch	21	1.9%	2	1.6%	5	1.5%	7	1.5%	7	3.9%
Magch combo										
1hit 1miss magch	17	1.5%			1	0.3%	9	2.0%	7	3.9%
1hit >1miss magch	8	0.7%			1	0.3%	2	0.4%	5	2.8%
1hit 1malf magch	3	0.3%			1	0.3%	1	0.2%		
1hit 1miss 1malf magch	2	0.2%					2	0.4%		
1hit >1miss 1malf magch	2	0.2%							2	1.1%
Hit miss malf combo										
1hit 1miss 1malf	59	5.3%	7	5.7%	18	5.5%	28	6.1%	4	2.2%
1hit >1miss 1malf	14	1.3%	1	0.8%	4	1.2%	6	1.3%	2	1.1%
Other (dm)	*6*	*0.5%*			*1*	*0.3%*	*3*	*0.7%*	*2*	1.1%
sum	**1109**	**1**	**123**	**1**	**329**	**1**	**459**	**1**	**178**	**1**

No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
All misses										
1miss	90	23.3%	1	16.7%	8	21.6%	33	23.2%	47	23.7%
>1miss	130	33.6%	3	50.0%	10	27.0%	47	33.1%	69	34.8%
Miss w malf										
1miss 1malf	26	6.7%			1	2.7%	11	7.7%	12	6.1%
>1miss 1malf	51	13.2%			10	27.0%	18	12.7%	23	11.6%
Miss w magch										

1miss magch	2	0.5%					1	0.7%	1	0.5%
>1miss magch	18	4.7%					7	4.9%	11	5.6%
Magch combo										
>1miss 1malf magch	3	0.8%							3	1.5%
NF only & NF combo										
1nf	66	17.1%	2	33.3%	8	21.6%	25	17.6%	31	15.7%
1malf 1nf	1	0.3%							1	0.5%
Hit miss malf combo										
Other (dm)										
sum	**387**	**1**	**6**	**1**	**37**	**1**	**142**	**1**	**198**	**1**
Barricade 150m 2 exposures, Firing Table 2-4										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
2hit only	245	59.9%	57	72.2%	97	62.2%	67	50.0%	18	64.3%
2hits w misses										
2hit 1miss	54	13.2%	6	7.6%	15	9.6%	28	20.9%	2	7.1%
2hit >1 miss	6	1.5%	1	1.3%	4	2.6%	1	0.7%		
2hits with malf	42	10.3%	12	15.2%	15	9.6%	11	8.2%	2	7.1%
2hits with magch	7	1.7%			3	1.9%	3	2.2%	1	3.6%
Magch combo										
2hit 1miss magch	2	0.5%			1	0.6%	1	0.7%		
2hit >1miss magch	3	0.7%					3	2.2%		
2hit 1malf magch	1	0.2%					1	0.7%		
Hit miss malf combo										
2hit 1miss 1malf	18	4.4%	1	1.3%	10	6.4%	6	4.5%	1	3.6%
2hit >1 miss 1malf	5	1.2%			2	1.3%	2	1.5%	1	3.6%
Other (dm)	*26*	*6.4%*	*2*	*2.5%*	*9*	*5.8%*	*11*	8.2%	*3*	10.7%
sum	**409**	**1**	**79**	**1**	**156**	**1**	**134**	**1**	**28**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
All misses	95	8.7%			9	4.3%	33	7.1%	52	14.9%
<2hits w misses										
1hit 1miss	175	16.0%	9	18.0%	35	16.7%	80	17.1%	51	14.7%
1hit >1miss	59	5.4%			14	6.7%	32	6.9%	11	3.2%
Miss w malf										
>=2miss 1malf	27	2.5%			8	3.8%	13	2.8%	6	1.7%
Miss with magch	9	0.8%					4	0.9%	5	1.4%
Magch combo										

1hit >1miss 1malf magch	2	0.2%							2	0.6%
1hit 1miss magch	7	0.6%	1	2.0%	1	0.5%	3	0.6%	2	0.6%
1hit >1miss magch	4	0.4%			2	1.0%			2	0.6%
2miss 1malf magch	1	0.1%							1	0.3%
NF only & NF combo										
1hit 1nf	270	24.7%	19	38.0%	62	29.7%	130	27.8%	52	14.9%
1hit 1malf 1nf	33	3.0%	3	6.0%	5	2.4%	19	4.1%	4	1.1%
1hit magch 1nf	8	0.7%			2	1.0%	3	0.6%	2	0.6%
2nf	174	15.9%	4	8.0%	24	11.5%	65	13.9%	80	23.0%
1miss 1malf 1nf	22	2.0%	2	4.0%	6	2.9%	6	1.3%	7	2.0%
1miss 1nf	108	9.9%	1	2.0%	17	8.1%	40	8.6%	47	13.5%
1miss magch 1nf	10	0.9%			1	0.5%	1	0.2%	9	2.6%
1malf 2nf	1	0.1%							1	0.3%
magch 2nf	2	0.2%							2	0.6%
1malf magch 2nf	1	0.1%								
Hit miss malf combo										
1hit 1miss 1malf	53	4.8%	9	18.0%	15	7.2%	23	4.9%	5	1.4%
1hit >1miss 1malf	16	1.5%	1	2.0%	6	2.9%	8	1.7%	1	0.3%
Other (dm)	*16*	*1.5%*	*1*	2.0%	*2*	1.0%	*7*	1.5%	*6*	1.7%
sum	**1093**	**1**	**50**	**1**	**209**	**1**	**467**	**1**	**348**	**1**
Barricade 200m 1 exposure, Firing Table 2-5										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
1 hit only	540	50.9%	86	68.8%	176	54.3%	204	47.8%	66	40.7%
1hit w misses										
1 hit 1 miss	150	14.1%	14	11.2%	46	14.2%	60	14.1%	25	15.4%
1 hit >1 miss	52	4.9%	4	3.2%	18	5.6%	18	4.2%	9	5.6%
1hit with malf	75	7.1%	7	5.6%	24	7.4%	33	7.7%	10	6.2%
1hit with magch	47	4.4%	2	1.6%	12	3.7%	23	5.4%	9	5.6%
Magch combo										
1hit 1miss magch	27	2.5%	1	0.8%	7	2.2%	14	3.3%	4	2.5%
1hit >1miss magch	18	1.7%	2	1.6%	7	2.2%	5	1.2%	4	2.5%
1hit 1malf magch	2	0.2%					2	0.5%		
1hit 1miss 1malf magch	2	0.2%					2	0.5%		
1hit >1miss 1malf magch	2	0.2%					1	0.2%		
Hit miss malf combo										
1hit 1miss 1malf	51	4.8%	6	4.8%	12	3.7%	22	5.2%	11	6.8%
1hit >1miss 1malf	25	2.4%	1	0.8%	2	0.6%	13	3.0%	7	4.3%

Other (dm)	*70*	6.6%	*2*	1.6%	*20*	6.2%	*30*	7.0%	*17*	10.5%
sum	**1061**	**1**	**125**	**1**	**324**	**1**	**427**	**1**	**162**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
All misses	197	44.7%	1	25.0%	12	28.6%	74	42.5%	108	50.5%
Miss with malf										
1miss 1malf	16	3.6%			9	21.4%	7	4.0%	6	2.8%
>1miss 1malf	68	15.4%	1	25.0%	8	19.0%	22	12.6%	27	12.6%
Miss with magch										
1miss magch	20	4.5%			2	4.8%	10	5.7%	7	3.3%
>1miss magch	52	11.8%	1	25.0%	5	11.9%	26	14.9%	21	9.8%
Magch combo										
1miss 1malf magch	1	0.2%					1	0.6%		
>1miss 1malf magch	7	1.6%	1	25.0%			4	2.3%	2	0.9%
NF only & NF combo										
1nf	79	17.9%			6	14.3%	29	16.7%	43	20.1%
1miss 1 malf 1nf	1	0.2%					1	0.6%		
Hit miss malf combo										
Other (dm)										
sum	**441**	**1**	**4**	**1**	**42**	**1**	**174**	**1**	**214**	**1**
Prone 100m 2 exposures, Firing Table 3-1										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
2hit only	221	28.5%	42	38.9%	79	29.7%	84	28.6%	12	13.8%
2hits w misses										
2hit 1miss	63	8.1%	4	3.7%	26	9.8%	23	7.8%	10	11.5%
2hit >1miss	23	3.0%	2	1.9%	5	1.9%	12	4.1%	4	4.6%
2hits with malf	94	12.1%	15	13.9%	35	13.2%	26	8.8%	15	17.2%
2hits with magch	162	20.9%	26	24.1%	61	22.9%	53	18.0%	14	16.1%
Magch combo										
2hit 1miss magch	63	8.1%	8	7.4%	18	6.8%	31	10.5%	5	5.7%
2hit >1miss magch	26	3.4%	1	0.9%	5	1.9%	15	5.1%	5	5.7%
2hit 1malf magch	34	4.4%	5	4.6%	16	6.0%	12	4.1%	1	1.1%
2hit 1miss 1malf magch	15	1.9%	1	0.9%	3	1.1%	7	2.4%	4	4.6%
2hit >1miss 1malf magch	7	0.9%			1	0.4%	5	1.7%	1	1.1%
Hit miss malf combo										
2hit 1miss 1malf	33	4.3%	2	1.9%	6	2.3%	14	4.8%	11	12.6%
2hit >1 miss 1malf	6	0.8%			2	0.8%	3	1.0%	1	1.1%

Other (dm)	*28*	*3.6%*	*2*	1.9%	*9*	3.4%	*9*	3.1%	*4*	4.6%
sum	**775**	**1**	**108**	**1**	**266**	**1**	**294**	**1**	**87**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Miss only	55	7.6%	1	4.8%	3	3.0%	22	7.2%	29	10.0%
<2hits w misses										
1hit 1miss	70	9.6%	3	14.3%	8	8.0%	40	13.0%	19	6.6%
1hit >1miss	44	6.1%	1	4.8%	2	2.0%	11	3.6%	29	10.0%
Miss w malf										
>1miss 1malf	34	4.7%	2	9.5%	2	2.0%	9	2.9%	21	7.3%
Miss with magch										
>1miss magch	38	5.2%	1	4.8%	6	6.0%	16	5.2%	15	5.2%
Magch combo										
1hit 1miss magch	38	5.2%	3	14.3%	7	7.0%	18	5.9%	10	3.5%
1hit >1miss magch	48	6.6%	1	4.8%	10	10.0%	19	6.2%	18	6.2%
1hit 1miss 1malf magch	7	1.0%			2	2.0%	4	1.3%	1	0.3%
1hit >1miss 1malf magch	13	1.8%					8	2.6%	5	1.7%
>=2miss 1malf magch	14	1.9%			1	1.0%	6	2.0%	7	2.4%
NF only & NF combo										
2nf	75	10.3%	1	4.8%	13	13.0%	33	10.7%	27	9.3%
1hit 1nf	104	14.3%	6	28.6%	15	15.0%	47	15.3%	31	10.7%
1miss 1nf	38	5.2%		0.0%	2	2.0%	16	5.2%	20	6.9%
1hit 1malf 1nf	27	3.7%	1	4.8%	12	12.0%	9	2.9%	4	1.4%
1hit magch 1nf	23	3.2%	1	4.8%	5	5.0%	10	3.3%	7	2.4%
1hit >1miss 1malf 1nf	1	0.1%							1	0.3%
1hit 1miss magch 1nf	1	0.1%					1	0.3%		
1miss 1malf 1nf	14	1.9%			2	2.0%	3	1.0%	8	2.8%
1miss magch 1nf	10	1.4%			1	1.0%	2	0.7%	7	2.4%
magch 2nf	1	0.1%					1	0.3%		
1malf 2nf	1	0.1%							1	0.3%
>1miss 1malf magch 1nf	1	0.1%							1	0.3%
Hit miss malf combo										
1hit 1miss 1malf	33	4.5%			6	6.0%	11	3.6%	16	5.5%
1hit >1miss 1malf	32	4.4%			2	2.0%	18	5.9%	11	3.8%
Other (dm)	5	*0.7%*			*1*	1.0%	*3*	1.0%	*1*	0.3%
sum	727	1	21	1	100	1	307	1	289	1
Prone 200m 2 exposures, Firing Table 3-2										

Kills	Total		EX		SS		MM		UQ	
2hit only	273	36.4%	49	40.8%	95	36.3%	103	36.1%	20	30.8%
2hits w misses										
2hit 1miss	87	11.6%	9	7.5%	32	12.2%	36	12.6%	7	10.8%
2hit >1miss	28	3.7%	1	0.8%	8	3.1%	12	4.2%	7	10.8%
2hits with malf	53	7.1%	7	5.8%	20	7.6%	24	8.4%	2	3.1%
2hits with magch	77	10.3%	24	20.0%	28	10.7%	22	7.7%	3	4.6%
Magch combo										
2hit >=1miss magch	71	9.5%	15	12.5%	26	9.9%	21	7.4%	7	10.8%
2hit 1malf magch	12	1.6%	4	3.3%	3	1.1%	2	0.7%	1	1.5%
2hit >=1miss 1malf magch	13	1.7%			3	1.1%	10	3.5%		
Hit miss malf combo										
2hit 1miss 1malf	52	6.9%	4	3.3%	15	5.7%	25	8.8%	5	7.7%
2hit >1 miss 1malf	18	2.4%	2	1.7%	7	2.7%	5	1.8%	2	3.1%
Other (dm)	*67*	*8.9%*	*5*	4.2%	*25*	9.5%	*25*	8.8%	*11*	16.9%
sum	**751**	**1**	**120**	**1**	**262**	**1**	**285**	**1**	**65**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Miss only	115	15.3%	1	11.1%	7	6.7%	41	13.0%	65	20.9%
NA										
2na	5	0.7%					2	0.6%	3	1.0%
1miss 1na	1	0.1%					1	0.3%		
<2hits w misses										
1hit 1miss	71	9.5%			16	15.4%	36	11.4%	19	6.1%
1hit >1miss	70	9.3%			9	8.7%	35	11.1%	24	7.7%
Miss w malf										
>=2miss 1malf	44	5.9%			3	2.9%	21	6.6%	22	7.1%
Miss with magch										
>=2miss magch	35	4.7%			5	4.8%	13	4.1%	17	5.5%
Magch combo										
1hit 1miss magch	33	4.4%	1	11.1%	9	8.7%	16	5.1%	5	1.6%
1hit >1miss magch	51	6.8%	2	22.2%	8	7.7%	26	8.2%	14	4.5%
>=2miss 1malf magch	11	1.5%			2	1.9%	4	1.3%	5	1.6%
1hit >=1miss 1malf magch	8	1.1%			5	4.8%	2	0.6%	1	0.3%
1hit 1miss 1malf 1magch	1	0.1%					1	0.3%		
NF only & NF combo										
2nf	84	11.2%			6	5.8%	26	8.2%	52	16.7%
1hit 1nf	50	6.7%			14	13.5%	16	5.1%	16	5.1%
1hit 1malf 1nf	22	2.9%	3	33.3%	2	1.9%	12	3.8%	10	3.2%

1hit magch 1nf	17	2.3%			2	1.9%	9	2.8%	6	1.9%
1hit >1miss 1malf 1nf										
1hit >=1malf magch 1nf	2	0.3%			2	1.9%			1	0.3%
1miss 1nf	42	5.6%			2	1.9%	17	5.4%	23	7.4%
1miss 1malf 1nf	5	0.7%					3	0.9%	2	0.6%
1miss magch 1nf	12	1.6%			2	1.9%	5	1.6%	5	1.6%
1miss 1malf magch 1nf	3	0.4%							2	0.6%
magch 2nf										
1malf 2nf	2	0.3%							2	0.6%
Hit miss malf combos										
1hit 1miss 1malf	16	2.1%			3	2.9%	9	2.8%	4	1.3%
1hit >1miss 1malf	42	5.6%	2	22.2%	5	4.8%	16	5.1%	12	3.9%
Other (dm)	*8*	*1.1%*			*2*	*1.9%*	*5*	*1.6%*	*1*	*0.3%*
sum	**750**	**1**	**9**	**1**	**104**	**1**	**316**	**1**	**311**	**1**
Prone 250m 1 exposure, Firing Table 3-3										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
1hit only	487	0.4737	80	63.0%	170	52.1%	186	44.8%	45	31.5%
1hit w misses										
1hit 1miss	175	17.0%	17	13.4%	57	17.5%	77	18.6%	20	14.0%
1hit >1miss	85	8.3%	4	3.1%	20	6.1%	41	9.9%	18	12.6%
1hit with malf	40	3.9%	1	0.8%	16	4.9%	18	4.3%	5	3.5%
1hit with magch	37	3.6%	4	3.1%	13	4.0%	13	3.1%	6	4.2%
Magch combo										
1hit 1miss magch	40	3.9%	5	3.9%	11	3.4%	15	3.6%	8	5.6%
1hit >1miss magch	25	2.4%			6	1.8%	13	3.1%	5	3.5%
1hit 1miss 1malf magch	2	0.2%								
1hit >=1miss 1malf magch	4	0.4%	1	0.8%	2	0.6%			3	2.1%
1hit 1malf magch	1	0.1%							1	0.7%
Hit miss malf combo										
1hit 1miss 1malf	41	4.0%	5	3.9%	9	2.8%	19	4.6%	6	4.2%
1hit >1miss 1malf	33	3.2%	4	3.1%	10	3.1%	11	2.7%	8	5.6%
Other (dm)	58	5.6%	6	4.7%	12	3.7%	22	5.3%	18	12.6%
sum	**1028**	**1**	**127**	**1**	**326**	**1**	**415**	**1**	**143**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Misses only	244	51.7%	1	50.0%	22	55.0%	99	53.2%	115	49.4%
NA										

1na	23	4.9%					7	3.8%	16	6.9%
Miss w malf										
1miss 1malf	23	4.9%	1	50.0%			8	4.3%	14	6.0%
>1miss 1malf	67	14.2%			6	15.0%	29	15.6%	30	12.9%
Miss w magch										
1miss magch	10	2.1%			1	2.5%	4	2.2%	5	2.1%
>1miss magch	31	6.6%			4	10.0%	11	5.9%	14	6.0%
Magch combo										
>=1miss 1malf magch	13	2.8%			4	10.0%	6	3.2%	3	1.3%
NF only & NF combo										
1nf	58	12.3%			3	7.5%	21	11.3%	34	14.6%
1miss 1 malf 1nf	1	0.2%					1	0.5%		
magch 1nf	1	0.2%							1	0.4%
Hit miss malf combo										
Other (dm)	1	0.2%							1	0.4%
sum	**472**	**1**	**2**	**1**	**40**	**1**	**186**	**1**	**233**	**1**
Prone 150m 2 exposures, Firing Table 3-4										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
2hit only	448	49.4%	78	63.9%	155	51.7%	164	46.1%	38	36.2%
2hits w misses										
2hit 1miss	109	12.0%	7	5.7%	38	12.7%	41	11.5%	22	21.0%
2hit >1miss	26	2.9%	1	0.8%	3	1.0%	15	4.2%	7	6.7%
2hits with malf	148	16.3%	24	19.7%	51	17.0%	53	14.9%	14	13.3%
2hits with magch	40	4.4%	4	3.3%	16	5.3%	16	4.5%	4	3.8%
Magch combo										
2hit >=1miss magch	18	2.0%	1	0.8%	7	2.3%	4	1.1%	6	5.7%
2hit 1malf magch	7	0.8%			5	1.7%	1	0.3%	1	1.0%
2hit >=1miss 1malf magch	5	0.6%			1	0.3%	4	1.1%		
Hit miss malf combo										
2hit 1miss 1malf	41	4.5%	2	1.6%	11	3.7%	22	6.2%	5	4.8%
2hit >1 miss 1malf	17	1.9%			1	0.3%	13	3.7%	4	3.8%
Other (dm)	47	5.2%	5	4.1%	12	4.0%	23	6.5%	4	3.8%
sum	**906**	**1**	**122**	**1**	**300**	**1**	**356**	**1**	**105**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Misses only	42	7.1%			4	6.1%	9	3.7%	28	10.3%
NA										

2na	120	20.2%			9	13.6%	45	18.4%	62	22.9%
1hit 1na	28	4.7%			3	4.5%	23	9.4%	2	0.7%
1hit >=1malf 1na	4	0.7%	1	14.3%	1	1.5%	2	0.8%		
magch 1na	1	0.2%							1	0.4%
1miss 1na	12	2.0%			2	3.0%	7	2.9%	3	1.1%
1miss 1malf 1na	1	0.2%					1	0.4%		
<2hits with misses										
1hit 1miss	77	12.9%	1	14.3%	11	16.7%	40	16.4%	24	8.9%
1hit >1miss	53	8.9%	1	14.3%	3	4.5%	19	7.8%	30	11.1%
Miss with malf										
>=2miss 1malf	32	5.4%			3	4.5%	11	4.5%	18	6.6%
Miss with magch										
>=2miss magch	5	0.8%							5	1.8%
Magch combo										
1hit 1miss magch	7	1.2%					4	1.6%	3	1.1%
>=2miss 1malf magch	1	0.2%							1	0.4%
1hit >1miss magch	9	1.5%			1	1.5%	6	2.5%	2	0.7%
1hit >=1miss 1malf magch	1	0.2%							1	0.4%
NF only & NF combo										
2nf	44	7.4%	1	14.3%	7	10.6%	11	4.5%	25	9.2%
1hit 1nf	59	9.9%	2	28.6%	9	13.6%	28	11.5%	20	7.4%
1hit 1malf 1nf	12	2.0%			2	3.0%	4	1.6%	5	1.8%
1hit magch 1nf	5	0.8%			1	1.5%	2	0.8%	2	0.7%
1miss 1nf	15	2.5%	1	14.3%	1	1.5%	3	1.2%	10	3.7%
1miss 1malf 1nf	3	0.5%			2	3.0%			1	0.4%
1miss magch 1nf	1	0.2%							1	0.4%
Hit miss malf combo										
1hit 1miss 1malf	24	4.0%			5	7.6%	13	5.3%	6	2.2%
1hit >1miss 1malf	31	5.2%			2	3.0%	13	5.3%	16	5.9%
Other (dm)	8	1.3%					3	1.2%	5	1.8%
sum	**595**	**1**	**7**	**1**	**66**	**1**	**244**	**1**	**271**	**1**

Prone 250m 2 exposures, Firing Table 3-5										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
2hit only	191	45.6%	50	47.6%	77	46.1%	51	45.1%	6	26.1%
2hits w misses										
2hit 1miss	78	18.6%	20	19.0%	27	16.2%	28	24.8%	1	4.3%

2hit >1miss	20	4.8%	3	2.9%	10	6.0%	6	5.3%		
2hits with malf	44	10.5%	17	16.2%	17	10.2%	8	7.1%	1	4.3%
2hits with magch	4	1.0%			3	1.8%	1	0.9%	1	4.3%
Magch combo										
2hit >=1miss magch	3	0.7%			1	0.6%	2	1.8%		
2hit 2malf magch	1	0.2%							1	4.3%
Hit miss malf combo										
2hit 1miss 1malf	24	5.7%	2	1.9%	13	7.8%	6	5.3%	3	13.0%
2hit >1 miss 1malf	14	3.3%	4	3.8%	5	3.0%	2	1.8%	2	8.7%
Other (dm)	*40*	*9.5%*	*9*	*8.6%*	*14*	8.4%	*9*	8.0%	*8*	34.8%
sum	**419**	**1**	**105**	**1**	**167**	**1**	**113**	**1**	**23**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Misses only	162	15.0%			26	13.1%	79	16.2%	54	15.3%
NA										
2na	297	27.5%	2	8.3%	33	16.6%	140	28.7%	117	33.2%
1hit 1na	26	2.4%	2	8.3%	6	3.0%	11	2.3%	5	1.4%
1hit 1malf 1na	5	0.5%			1	0.5%	4	0.8%		
1miss 1malf 1na	3	0.3%			1	0.5%	2	0.4%		
1miss 1na	46	4.3%			11	5.5%	22	4.5%	12	3.4%
<2hit w misses										
1hit 1miss	87	8.0%	4	16.7%	22	11.1%	45	9.2%	15	4.3%
1hit >1miss	83	7.7%	2	8.3%	27	13.6%	36	7.4%	18	5.1%
Miss with malf										
>=2miss 1malf	62	5.7%			9	4.5%	26	5.3%	26	7.4%
Miss with magch										
>=2miss magch	8	0.7%	1	4.2%			1	0.2%	6	1.7%
Magch combo										
1hit 1miss magch	2	0.2%			1	0.5%			1	0.3%
1hit >1miss magch	1	0.1%					1	0.2%		
2miss >=1malf magch	2	0.2%							2	0.6%
NF only & NF combo										
2nf	83	7.7%	2	8.3%	14	7.0%	28	5.7%	38	10.8%
1hit 1nf	56	5.2%	4	16.7%	18	9.0%	19	3.9%	13	3.7%
1hit 1malf 1nf	12	1.1%	1	4.2%	5	2.5%	4	0.8%	2	0.6%
1miss 1nf	65	6.0%	1	4.2%	8	4.0%	32	6.6%	22	6.3%
1malf 2nf	1	0.1%					1	0.2%		
1miss 1malf 1nf	9	0.8%	1	4.2%	1	0.5%	2	0.4%	5	1.4%
1miss magch 1nf	4	0.4%			1	0.5%	1	0.2%	2	0.6%

1hit magch 1nf	1	0.1%							1	0.3%
Hit miss malf combo										
1hit 1miss 1malf	18	1.7%	1	4.2%	4	2.0%	10	2.0%	3	0.9%
1hit >1miss 1malf	36	3.3%	3	12.5%	9	4.5%	15	3.1%	9	2.6%
Other (dm)	*12*	*1.1%*			2	1.0%	9	1.8%	1	0.3%
sum	**1081**	**1**	**24**	**1**	**199**	**1**	**488**	**1**	**352**	**1**
Prone 300m 1 exposure, Firing Table 3-6										
Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
1 hit only	208	54.2%	49	55.7%	79	58.5%	60	48.4%	17	58.6%
1hit w misses										
1 hit 1 miss	69	18.0%	18	20.5%	19	14.1%	28	22.6%	3	10.3%
1 hit >1 miss	30	7.8%	4	4.5%	10	7.4%	12	9.7%	3	10.3%
1hit with malf	25	6.5%	6	6.8%	12	8.9%	8	6.5%		
1hit with magch	2	0.5%	2	2.3%						
Magch combo										
1hit >=1miss magch	6	1.6%	1	1.1%	1	0.7%	3	2.4%	1	3.4%
1hit 3miss 1malf magch	1	0.3%							1	3.4%
Hit miss malf combo										
1 hit 1miss 1malf	14	3.6%	3	3.4%	3	2.2%	6	4.8%	1	3.4%
1hit >1miss 1malf	13	3.4%	4	4.5%	2	1.5%	3	2.4%	1	3.4%
Other (dm)	*16*	*4.2%*	*1*	1.1%	*9*	6.7%	*4*	3.2%	*2*	6.9%
sum	**384**	**1**	**88**	**1**	**135**	**1**	**124**	**1**	**29**	**1**
No Kills	**Total**		**EX**		**SS**		**MM**		**UQ**	
Misses only	328	29.4%	15	36.6%	88	38.1%	129	27.0%	86	24.9%
1NA	612	54.8%	14	34.1%	116	50.2%	280	58.7%	190	55.1%
1malf 1na	2	0.2%					2	0.4%		
Miss with malf										
1miss 1malf	21	1.9%	1	2.4%	7	3.0%	9	1.9%	4	1.2%
>1miss 1malf	50	4.5%	5	12.2%	8	3.5%	21	4.4%	16	4.6%
Miss with magch	7	0.6%	2	4.9%			3	0.6%	2	0.6%
Magch combo										
NF only & NF combo										
1nf	93	8.3%	4	9.8%	12	5.2%	31	6.5%	46	13.3%
1malf 1nf	3	0.3%					2	0.4%	1	0.3%
Hit miss malf combo										
sum	**1116**	**1**	**41**	**1**	**231**	**1**	**477**	**1**	**345**	**1**

Appendix F

Descriptive Statistics

Table F-1
Descriptive Statistics on AQ and CFF for All Soldiers

	AQ Scores		CFF Scores			
	Practice	Record	Practice Hits	Practice Points	Record Hits	Record Points
N	1920	1976	1884	1884	1820	1820
Mean	24.60	26.66	16.56	40.78	18.05	45.09
Median	25	27	17	42	18	46
Mode	27	29	18	45	18	50
SD	7.12	6.70	5.07	14.64	4.47	13.30
Min	0	1	0	0	0	0
Max	40	40	26	71	26	71
% EX	4	7	6	7	10	10
% SS	24	31	17	19	23	26
% MM	37	37	39	37	42	39
% UQ	35	25	38	37	25	25

Table F-2
Descriptive Statistics on AQ and CFF for Current POI

	Current BRM POI				
	AQ then CFF			CFF then AQ	
	OSUT Co M4 w M68	OSUT Co M4 w BUIS	BCT Co M16A4 w IS	OSUT Co M4 w M68	BCT Co M16A4 w IS
AQ Practice					
N	162	174	227	173	195
Mean	26.28	23.34	22.93	28.61	21.11
Median/Mode	27/32	24/22	24/25	30/33	22/27
St Dev	6.75	5.77	7.05	6.61	6.54
Min - Max	4-38	2-38	1-37	7-39	2-35
AQ Record					
N	180	177	226	175	202
Mean	27.84	25.70	25.34	30.91	22.95
Median/Mode	28/33	27/29	27/29	32/33	24/25
St Dev	6.01	6.11	6.74	5.19	5.85
Min - Max	8-40	6-37	8-37	15-40	7-38
% EX	7.78	3.96	2.21	17.71	1.00
% SS	35.55	22.60	29.20	50.29	10.89
% MM	36.67	43.50	38.50	24.57	45.54
% UQ	20.00	29.94	30.09	7.43	42.57
CFF Practice Points					
N	165	170	217	176	193
Mean	45.76	31.36	40.89	46.11	38.81
Median/Mode	49/58	31/25	41/45	46/41	40/45
St Dev	14.27	13.06	13.64	13.73	11.55
Min - Max	0-71	0-67	1-71	10-71	1-67
CFF Record Points					
N	165	165	151	174	201
Mean	48.59	42.56	44.62	51.90	40.64
Median/Mode	50/63	45/41	46/45	51.50/50	41/45
St Dev	12.28	13.71	12.83	10.46	10.89
Min - Max	8-71	5-67	9-67	11-71	13-71
CQ Practice Hits					
N	165	170	217	176	193
Mean	18.20	13.22	16.65	18.43	16.02
Median/Mode	19/22	13/13	17/18	19/18	16/15
St Dev	4.99	4.65	4.74	4.52	4.10
Min - Max	0-26	0-25	1-26	6-26	1-25
CFF Record Hits					
N	165	165	151	174	201
Mean	19.25	17.16	17.80	20.32	16.64
Median/Mode	19/18	18/19	18/21	20/20	17/18
St Dev	4.01	4.76	4.32	3.38	3.70
Min - Max	5-26	2-25	6-25	5-26	7-26

Table F-3
Descriptive Statistics on AQ and CFF for Legacy POI

	Legacy BRM POI				
	AQ then CFF			CFF then AQ	
	OSUT Co M4 w M68	OSUT Co M4 w BUIS	BCT Co M16A4 w IS	OSUT Co M4 w M68	BCT Co M16A4 w IS
AQ Practice					
N	180	207	230	141	231
Mean	27.54	24.26	25.66	29.86	19.68
Median/Mode	28/34	25/25	26/24	31/32	21/22
St Dev	5.90	5.93	6.40	5.47	7.32
Min -Max	4-38	6-35	3-38	12-40	0-36
AQ Record					
N	190	212	238	152	227
Mean	28.44	26.42	28.10	31.19	22
Median/Mode	29/30	27/27	29/33	32/34	23/24
St Dev	5.23	5.77	5.79	5.49	7.69
Min -Max	14-39	11-38	7-39	11-40	1-36
% EX	5.79	4.72	8.82	21.05	2.20
% SS	42.63	25.00	35.29	49.34	14.98
% MM	37.37	46.23	38.66	23.03	35.68
% UQ	14.21	24.05	17.23	6.58	47.14
CFF Practice Points					
N	186	198	206	146	227
Mean	46.33	38.48	45.37	50.42	28.74
Median/Mode	47/45	39/41	46/46	53/67	29/29
St Dev	12.23	13.10	12.36	13.79	13.21
Min - Max	3-71	1-71	6-71	12-71	0-59
CFF Record Points					
N	184	190	230	153	207
Mean	46.53	43.85	46.61	54.84	34.25
Median/Mode	46/63	44/59	47/63	58/58	35/31
St Dev	10.79	12.14	12.62	11.81	13.33
Min - Max	17-67	11-67	0-71	8-71	1-63
CFF Practice Hits					
N	186	198	206	146	227
Mean	18.49	16.12	18.27	19.56	12.11
Median/Mode	19/18	17/18	19/19	20.50/21	12/11
Mode	18	18	19	21	11
St Dev	4.10	4.46	4.11	4.64	4.81
Min - Max	3-26	1-26	3-26	6-26	0-23
CFF Record Hits					
N	184	190	230	153	207
Mean	18.62	17.86	18.64	21.10	14.15
Median/Mode	19/17	18/17	19/17	22/22	15/16
St Dev	3.54	4.01	4.19	3.76	4.74
Min - Max	8-25	5-25	0-26	5-26	1-24

Table F-4
AQ and CFF Correlations for all Soldiers

	Record AQ	Practice CFF Hits	Practice CFF Points	Record CFF Hits	Record CFF Points
Practice AQ	.56	.44	.44	.44	.44
Record AQ	---	.42	.42	.46	.46
Practice CFF Hits	---	---	.98	.55	.55
Practice CFF Points	---	---	---	.54	.54
Record CFF Hits	---	---	---	---	.99

Table F-5
Part-whole Correlations in Record CFF by Marksmanship Category

	Marksmanship Category	Hits Kneeling	Hits Barricade	Hits Prone
Hits Total	EX (N=172)	.06	.44	.52
	SS (N=479)	.23	.24	.41
	MM (N=715)	.17	.24	.48
	UQ (N=454)	.49	.60	.53
	Marksmanship	Points Kneeling	Points Barricade	Points Prone
Points Total	EX (N=172)	.08	.42	.54
	SS (N=479)	.21	.28	.39
	MM (N=715)	.21	.26	.38
	UQ (N=454)	.51	.57	.43

Table F-6
Part-whole Correlation Matrix for CFF Record Fire – All Soldiers

	Hits Kneeling	Hits Barricade	Hits Prone
Hits Total	.61	.74	.81
	Kills Kneeling	Kills Barricade	Kills Prone
Kills Total	.62	.73	.80
	Points Kneeling	Points Barricade	Points Prone
Points Total	.62	.73	.80
	Rounds Fired by Position		
	Kneeling	Barricade	Prone
Rounds Total	.65	.68	.59
Hits Total	-.08	.00	.15
Kills Total	-.08	-.01	.13
Points Total	-.08	-.01	.14

Table F-7

AQ Score and CFF Hit Correlations for Companies in the Current POI

Company	Current POI			
		AQ Record	CFF Practice	CFF Record
OSUT Co	AQ Practice	.40	.37	.41
CFF then AQ	AQ Record	---	.23	.38
M4 w M68	CFF Practice	---	---	.42
BCT Co	AQ Practice	.36	.47	.33
CFF then AQ	AQ Record	---	.30	.29
M16A4 w IS	CFF Practice	---	---	.53
BCT Co	AQ Practice	.47	.33	.34
AQ then CFF	AQ Record	---	.42	.42
M16A4 w IS	CFF Practice	---	---	.54
OSUT Co	AQ Practice	.37	.29	.24
AQ then CFF	AQ Record	---	.39	.47
M4 w BUIS	CFF Practice	---	---	.48
OSUT Co	AQ Practice	.46	.24	.23
AQ then CFF	AQ Record	---	.19	.36
M4 w M68	CFF Practice	---	---	.47

Table F-8

AQ and CFF Correlations for Companies in the Legacy POI

Company	Legacy POI			
		AQ Record	CFF Practice	CFF Record
OSUT Co	AQ Practice	.37	.31	.29
CFF then AQ	AQ Record	---	.31	.26
M4 w M68	CFF Practice	---	---	.37
BCT Co	AQ Practice	.55	.51	.46
CFF then AQ	AQ Record	---	.40	.33
M16A4 w IS	CCF Practice	---	---	.56
BCT Co	AQ Practice	.58	.42	.32
AQ then CFF	AQ Record	---	.34	.37
M16A4 w IS	CFF Practice	---	---	.39
OSUT Co	AQ Practice	.39	.19	.25
AQ then CFF	AQ Record	---	.32	.35
M4 w BUIS	CFF Practice	---	---	.46
OSUT Co	AQ Practice	.49	.10	.27
AQ then CFF	AQ Record	---	.12	.25
M4 w M68	CFF Practice	---	---	.42

Table F-9
Part-whole Correlations for CFF Record Fire by Company

	Company	Score and Position		
		Hits Kneeling	Hits Barricade	Hits Prone
Hits Total	Legacy BCT M16 CFF then AQ	.67	.77	.75
	Legacy OSUT M4 M68 CFF then AQ	.55	.70	.81
	Legacy BCT M16 AQ then CFF	.62	.72	.84
	Legacy OSUT M4 M68 AQ then CFF	.55	.67	.78
	Legacy OSUT M4 BUIS AQ then CFF	.63	.66	.78
	Current BCT M16 CFF then AQ	.56	.69	.75
	Current OSUT M4 M68 CFF then AQ	.55	.69	.71
	Current BCT M16 AQ then CFF	.60	.74	.81
	Current OSUT M4 M68 AQ then CFF	.56	.71	
	Current OSUT M4 BUIS AQ then CFF	.64	.78	.82
		Kills Kneeling	Kills Barricade	Kills Prone
Kills Total	Legacy BCT M16 CFF then AQ	.69	.75	.70
	Legacy OSUT M4 M68 CFF then AQ	.58	.74	.80
	Legacy BCT M16 AQ then CFF	.61	.71	.83
	Legacy OSUT M4 M68 AQ then CFF	.60	.67	.74
	Legacy OSUT M4 BUIS AQ then CFF	.64	.65	.79
	Current BCT M16 CFF then AQ	.56	.71	.74
	Current OSUT M4 M68 CFF then AQ	.56	.66	.70
	Current BCT M16 AQ then CFF	.63	.68	.74
	Current OSUT M4 M68 AQ then CFF	.57	.72	.82
	Current OSUT M4 BUIS AQ then CFF	.64	.77	.80
		Points Kneeling	Points Barricade	Points Prone
Points Total	Legacy BCT M16 CFF then AQ	.68	.75	.72
	Legacy OSUT M4 M68 CFF then AQ	.57	.73	.81
	Legacy BCT M16 AQ then CFF	.62	.71	.83
	Legacy OSUT M4 M68 AQ then CFF	.59	.67	.75
	Legacy OSUT M4 BUIS AQ then CFF	.64	.65	.78
	Current BCT M16 CFF then AQ	.56	.71	.74
	Current OSUT M4 M68 CFF then AQ	.56	.67	.70
	Current BCT M16 AQ then CFF	.61	.70	.80
	Current OSUT M4 M68 AQ then CFF	.57	.72	.83
	Current OSUT M4 BUIS AQ then CFF	.64	.78	.81

Table F-10
Descriptive Statistics on AQ and CFF for Drill Sergeants and Drill Sergeant Candidates

AQ Record	Drill Sergeants	Drill Sergeant Candidates
N	28	89
Mean	29.39	23.17
Median/Mode	31/35	24/19
St Dev	5.92	6.08
Min – Max	15-37	9-36
% EX	7.14	1.13
% SS	50.00	16.85
% MM	32.15	41.57
% UQ	10.71	40.45
CFF Record		
N	29	86
Mean	49.76	31.53
Median/Mode	50/46	32/35
St Dev	12.93	12.98
Min – Max	19-71	0-62
CQ Record Hits		
N	29	86
Mean	19.59	13.36
Median/Mode	20/19	14/11
St Dev	4.23	4.64
Min – Max	10-26	0-23

Table F-11
AQ and CFF Correlations for Drill Sergeants and Drill Sergeant Candidates

	CFF Record Points	CQ Record Hits
Drill Sergeants		
AQ Record	.42	.41
CFF Record Points	------	.99
Drill Sergeant Candidates		
AQ Record	.49	.49
CFF Record Points	------	.98

Appendix G

AQ and CFF Frequency Distributions

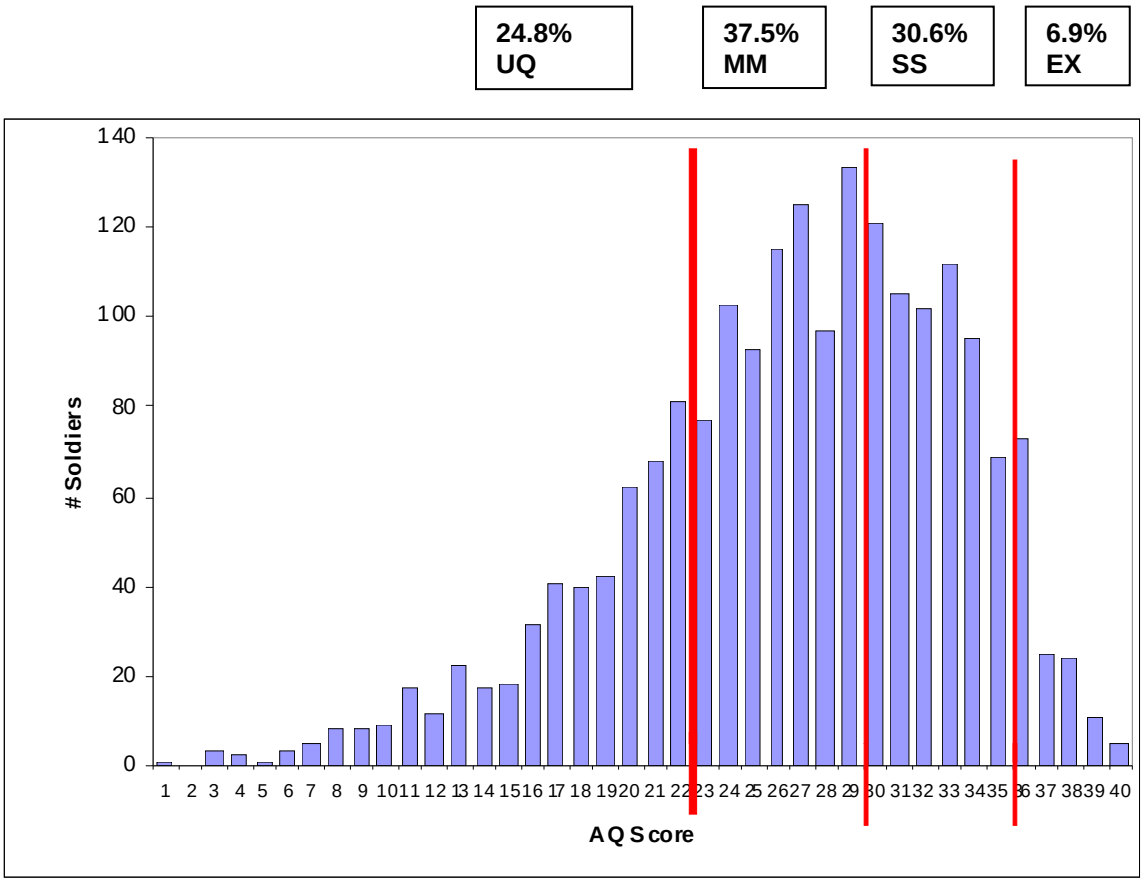

Figure G-1. Distribution of AQ scores and percentage of Soldiers in marksmanship categories for Soldier sample.

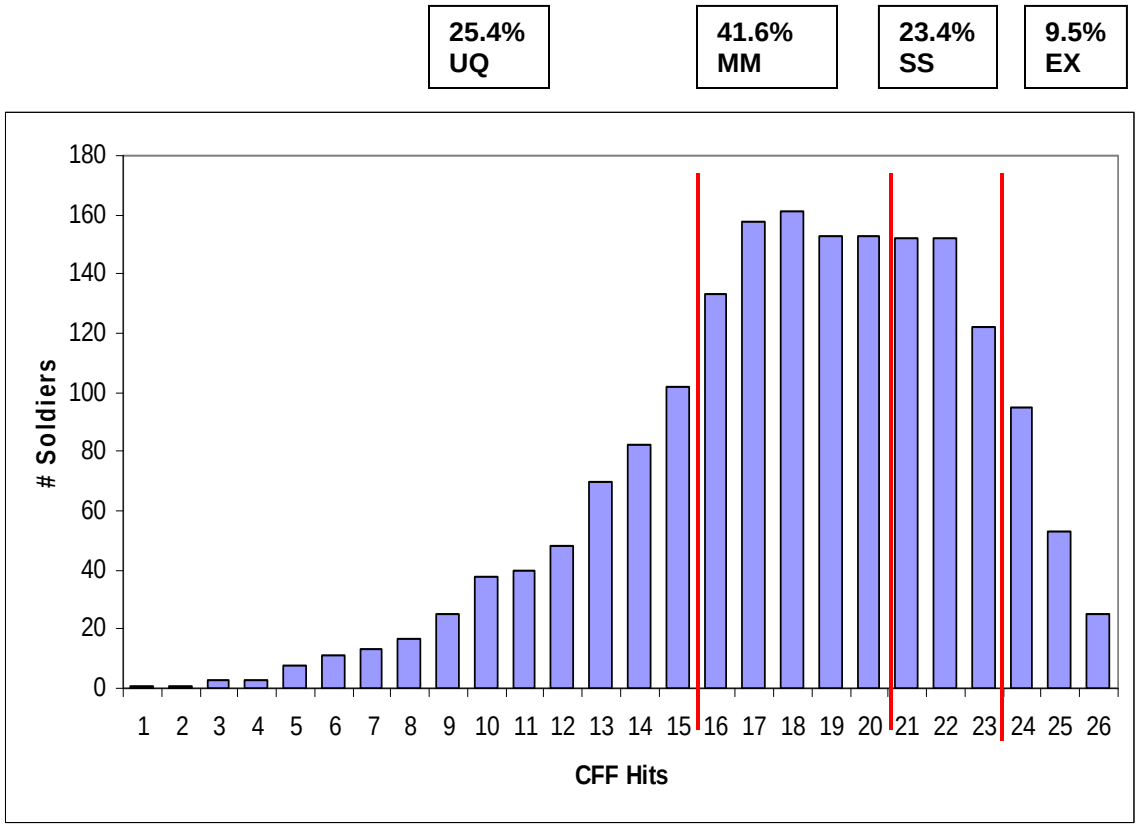

Figure G-2. Distribution of CFF hits and percentage of Soldiers in marksmanship categories for Soldier sample.

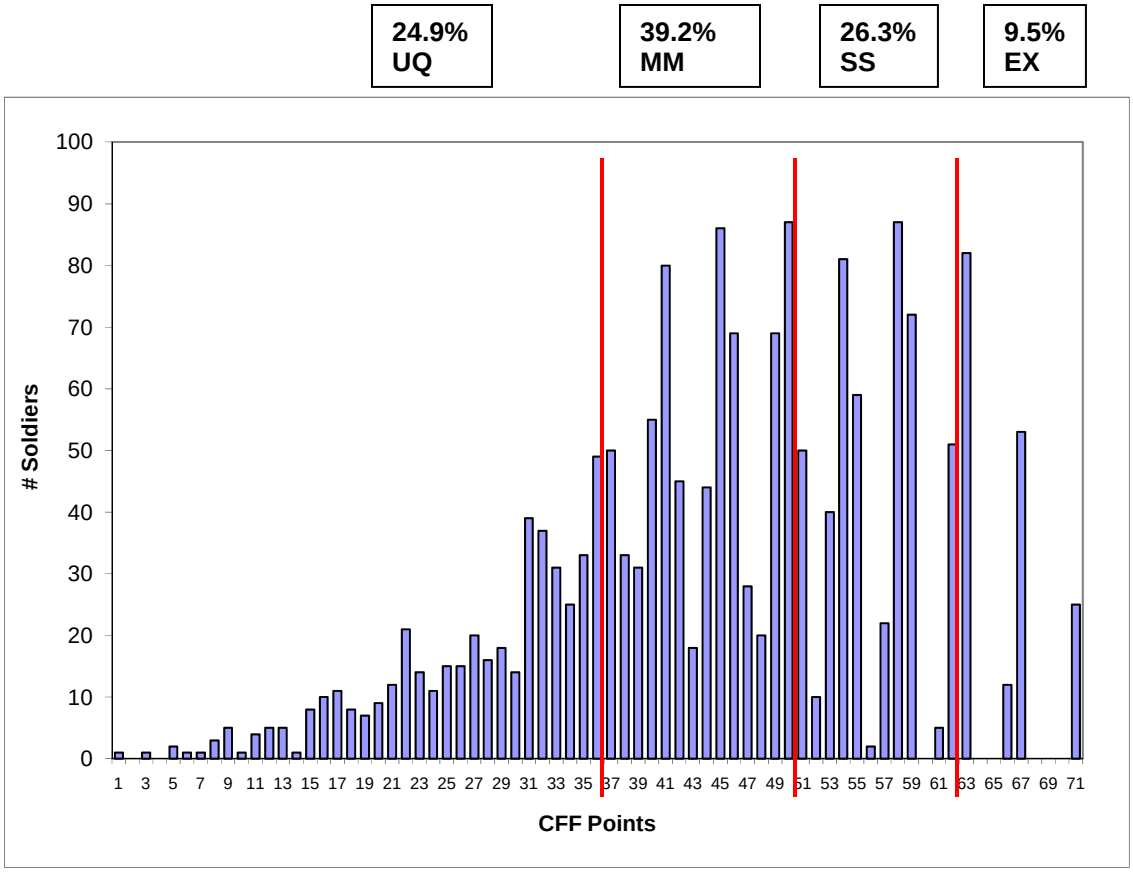

Figure G-3. Distribution of CFF points and percentage of Soldiers in marksmanship categories for Soldier sample.

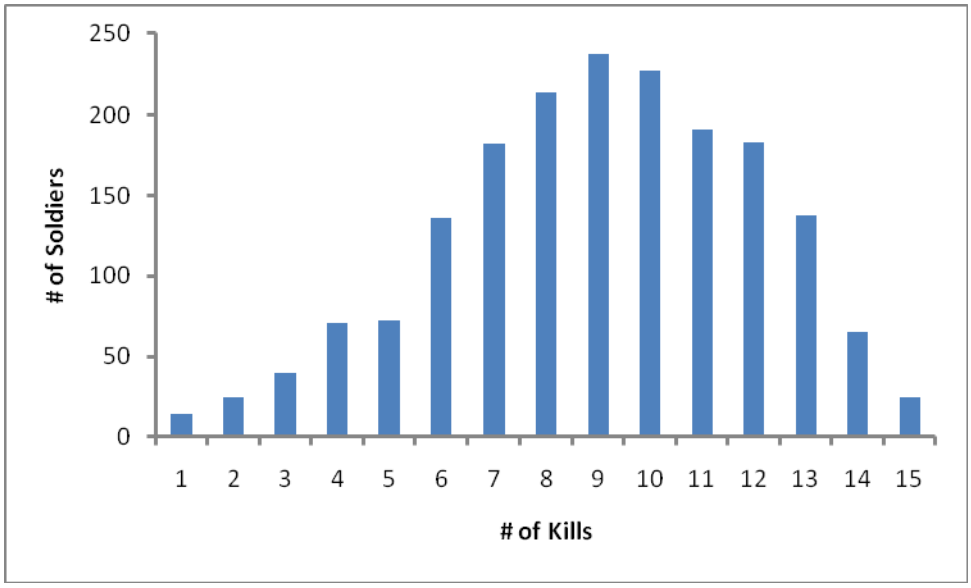

Figure G-4. Distribution of CFF kills for Soldier sample.

Table G-1. *Percentage Soldiers Below and Above Potential High and Low Kill Cut-points* (for TPU determination)

	Percentage of Soldiers in T and U Categories					
	Greatest %				Least %	
	Kill Range	% Soldiers	Kill Range	% Soldiers	Kill Range	% Soldiers
"T"	12 to 15 Kills	22.6%	13 to Kills	12.5%	14 to 15 Kills	4.9%
"P"	9 to 11 Kills	36.0%	8 to 12 Kills	57.8%	7 to 13 Kills	75.4%
"U"	0 to 8 Kills	41.5%	0 to 7 Kills	29.7%	0 to 6 Kills	19.7%

Table G-2
Frequency Distributions of CFF Points, Hits and Kills

CFF Points	# / % Soldiers	Points contd'	# / % Soldiers	CFF Hits	# / % Soldiers	CFF Kills	# / % Soldiers
0-1	2 / 0.1	37	50 / 2.7	0-1	2 / 0.2	0-1	14 / 0.7
2	0 / 0.0	38	33 / 1.8	2	1 / 0.1	2	25 / 1.4
3	1 / 0.1	39	31 / 1.7	3	3 / 0.2	3	40 / 2.2
4	0 / 0.0	40	55 / 3.0	4	3 / 0.2	4	71 / 3.9
5	2 / 0.1	41	80 / 4.4	5	8 / 0.4	5	72 / 4.0
6	1 / 0.1	42	45 / 2.5	6	11 / 0.6	6	136 / 7.5
7	1 / 0.1	43	18 / 1.0	7	13 / 0.7	7	182 / 10.0
8	3 / 0.2	44	44 / 2.4	8	17 / 0.9	8	214 / 11.8
9	5 / 0.3	45	86 / 4.7	9	25 / 1.4	9	237 / 13.0
10	1 / 0.1	46	69 / 3.8	10	38 / 2.1	10	227 / 12.5
11	4 / 0.2	47	29 / 1.5	11	40 / 2.2	11	191 / 10.5
12	5 / 0.3	48	20 / 1.1	12	48 / 2.6	12	183 / 10.1
13	5 / 0.3	49	69 / 3.8	13	70 / 3.8	13	138 / 7.6
14	1 / 0.1	50	87 / 4.8	14	82 / 4.5	14	65 / 3.6
15	8 / 0.4	51	50 / 2.7	15	102 / 5.6	15	25 / 1.4
16	10 / 0.5	52	10 / 0.5	16	133 / 7.3		
17	11 / 0.6	53	40 / 2.2	17	158 / 8.7		
18	8 / 0.4	54	81 / 4.5	18	161 / 8.8		
19	7 / 0.4	55	59 / 3.2	19	153 / 8.4		
20	9 / 0.5	56	2 / 0.1	20	152 / 8.4		
21	12 / 0.7	57	22 / 1.2	21	152 / 8.4		
22	21 / 1.2	58	87 / 4.8	22	152 / 8.4		
23	14 / 0.8	59	72 / 4.0	23	122 / 6.7		
24	11 / 0.6	60	5 / 0.3	24	95 / 5.2		
25	15 / 0.8	61	51 / 2.8	25	53 / 2.9		
26	15 / 0.8	62	82 / 4.5	26	25 / 1.4		
27	20 / 1.1	63	12 / 0.7				
28	16 / 0.9	64	0 / 0.0				
29	18 / 1.0	65	0 / 0.0				
30	14 / 0.8	66	12 / 0.7				
31	39 / 2.1	67	53 / 2.9				
32	37 / 2.0	68	0 / 0.0				
33	31 / 1.7	69	0 / 0.0				
34	25 / 1.4	70	0 / 0.0				
35	33 / 1.8	71	25 / 1.4				
36	49 / 2.7						

Note. N = 1820.

Table G-3
Frequency Distribution of Record Fire Scores

Score (# Hits)	# / % Soldiers	Score (# Hits) cont'd	# / % Soldiers
1	1 / 0.1	21	68 / 3.4
2	0 / 0.0	22	81 / 4.1
3	3 / 0.2	23	77 / 3.9
4	2 / 0.1	24	103 / 5.2
5	1 / 0.1	25	93 / 4.7
6	3 / 0.2	26	115 / 5.8
7	5 / 0.3	27	125 / 6.3
8	8 / 0.4	28	97 / 4.9
9	8 / 0.4	29	133 / 6.7
10	9 / 0.5	30	121 / 6.1
11	17 / 0.9	31	105 / 5.3
12	12 / 0.6	32	102 / 5.2
13	22 / 1.1	33	112 / 5.7
14	17 / 0.9	34	95 / 4.8
15	18 / 0.9	35	69 / 3.5
16	31 / 1.6	36	73 / 3.7
17	41 / 2.1	37	25 / 1.3
18	40 / 2.0	38	24 / 1.2
19	42 / 2.1	39	11 / 0.6
20	62 / 3.1	40	5 / 0.3

Note. N = 1976.

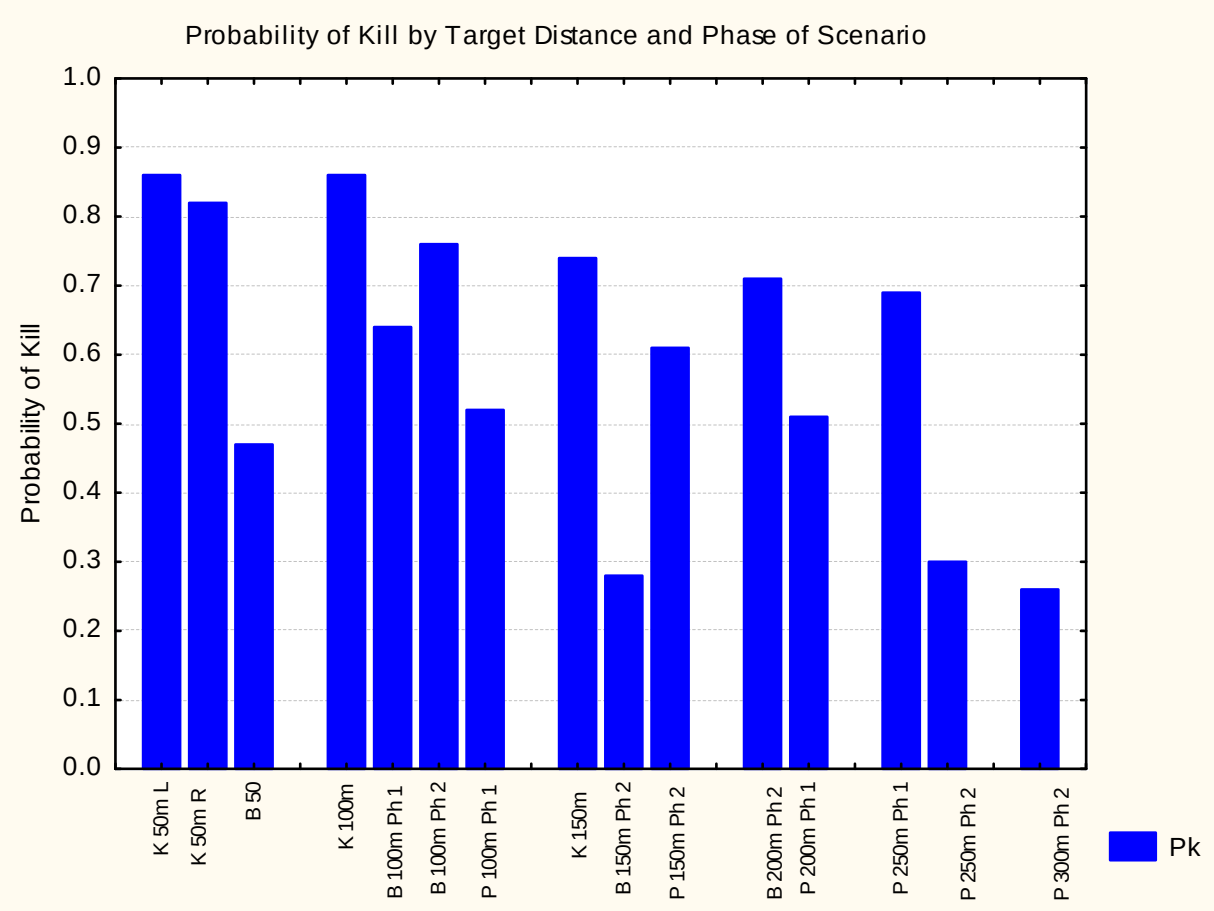

Figure G-5. Probability of kill for each target in the CFF scenario. (Targets ordered by distance. For each distance they are ordered by the firing table sequence in the CFF scenario: Kneeling/barricade/prone. Nearest targets are in the first firing tables; farther targets in later firing tables.)

Appendix H

POI Effects on AQ Scores and CFF Hits

Table H-1
ANOVA for AQ Scores

Source	Sum of Squares	DF	Mean Square	F	Significance	Partial Eta Squared
POI	82.08	1	82.08	2.21	.137	.00
Sequence	111.03	1	111.03	2.99	.084	.00
Weapon Sight	11434.14	1	11434.14	307.75	.000	.14
POI by Sequence	254.25	1	254.25	6.84	.009	.00
POI by Weapon Sight	.02	1	.02	.00	.984	.00
Sequence by Weapon Sight	5024.27	1	5024.27	135.23	.000	.06
POI by Sequence by Weapon Sight	159.16	1	159.16	4.28	.039	.00
Error	73119.46	1968	37.15			
Total	1493020.00	1976				

Table H-2
Descriptives for AQ Scores

POI	Sequence	Weapon Sight	Mean	SD	N
Legacy	AQ-CFF	CCO	28.44	5.23	190
		Iron	27.31	5.84	447
		Total	27.65	5.68	637
	CFF-AQ	CCO	31.19	5.49	152
		Iron	22.00	7.69	227
		Total	25.69	8.23	379
	Total	CCO	29.66	5.51	342
		Iron	25.52	6.98	674
		Total	26.92	6.81	1016
Current	AQ-CFF	CCO	27.84	6.01	180
		Iron	25.50	6.46	403
		Total	26.22	6.42	583
	CFF-AQ	CCO	30.91	5.19	175
		Iron	22.95	5.85	202
		Total	26.64	6.82	377

POI	Sequence	Weapon Sight	Mean	SD	N
	Total	CCO	29.35	5.82	355
		Iron	24.65	6.38	605
		Total	26.39	6.58	960
Total	AQ-CFF	CCO	28.15	5.63	370
		Iron	26.45	6.21	850
		Total	26.96	6.08	1220
	CFF-AQ	CCO	31.04	5.32	327
		Iron	22.45	6.90	429
		Total	26.17	7.57	756
	Total	CCO	29.51	5.67	697
		Iron	25.11	6.71	1279
		Total	26.66	6.70	1976

Table H-3
ANOVA for AQ Scores in Legacy POI

Source	Sum of Squares	DF	Mean Square	F	Significance	Partial Eta Squared
Sequence	352.72	1	352.72	9.32	.002	.01
Weapon Sight	5763.94	1	5763.94	152.33	.000	.13
Sequence by Weapon Sight	3506.44	1	3506.44	92.67	.000	.08
Error	38292.34	1012	37.84			
Total	783084.00	1016				

Table H-4
ANOVA for AQ Scores in Current POI

Source	Sum of Squares	DF	Mean Square	F	Significance	Partial Eta Squared
Sequence	14.54	1	14.54	.40	.528	.000
Weapon Sight	5670.76	1	5670.76	155.66	.000	.14
Sequence by Weapon Sight	1687.62	1	1687.62	46.33	.000	.05
Error	34827.12	956	36.43			
Total	709936.00	960				

Table H-5
ANOVA for CFF Hits

Source	Sum of Squares	DF	Mean Square	F	Significance	Partial Eta Squared
POI	59.33	1	59.33	3.57	.059	.002
Sequence	52.00	1	52.00	3.13	.077	.002
Weapon Sight	4153.50	1	4153.50	250.17	.000	.12
POI by Sequence	92.06	1	92.06	5.55	.019	.00
POI by Weapon Sight	83.37	1	83.37	5.02	.025	.00
Sequence by Weapon Sight	1854.25	1	1854.25	111.68	.000	.06
POI by Sequence by Weapon Sight	569.43	1	569.43	34.30	.000	.02
Error	30084.28	1812	16.60			
Total	629020.00	1820				

Table H-6
Descriptives for CFF Hits

POI	Sequence	Weapon Sight	Mean	SD	N
Legacy	AQ-CFF	CCO	18.62	3.54	184
		Iron	18.29	4.12	420
		Total	18.39	3.95	604
	CFF-AQ	CCO	21.10	3.78	153
		Iron	14.15	4.74	207
		Total	17.10	5.54	360
	Total	CCO	19.74	3.84	337
		Iron	16.92	4.75	627
		Total	17.91	4.65	964
Current	AQ-CFF	CCO	19.25	4.01	165
		Iron	17.47	4.56	316
		Total	18.08	4.46	481
	CFF-AQ	CCO	20.32	3.38	174
		Iron	16.64	3.70	201
		Total	18.35	4.00	375
	Total	CCO	19.80	3.73	339
		Iron	17.15	4.26	517
		Total	18.20	4.26	856
Total	AQ-CFF	CCO	18.92	3.78	349
		Iron	17.94	4.33	736
		Total	18.25	4.19	1085

POI	Sequence	Weapon Sight	Mean	SD	N
	CFF-AQ	CCO	20.69	3.58	327
		Iron	15.38	4.43	408
		Total	17.74	4.85	735
	Total	CCO	19.77	3.78	676
		Iron	17.02	4.54	1144
		Total	18.05	4.47	1820

Table H-7
ANOVA for CFF Hits in Legacy POI

Source	Sum of Squares	DF	Mean Square	F	Significance	Partial Eta Squared
Sequence	144.04	1	144.04	8.55	.004	.01
Weapon Sight	2760.84	1	2760.84	163.83	.000	.15
Sequence by Weapon Sight	2284.03	1	2284.03	135.54	.000	.12
Error	16177.82	960	16.85			
Total	330025.00	964				

Table H-8
ANOVA for CFF Hits in Current POI

Source	Sum of Squares	DF	Mean Square	F	Significance	Partial Eta Squared
Sequence	2.79	1	2.79	.17	.680	.00
Weapon Sight	1500.66	1	1500.66	91.94	.000	.10
Sequence by Weapon Sight	180.75	1	180.75	11.07	.001	.01
Error	13906.46	852	16.32			
Total	298995.00	856				

Appendix I

Acronyms

AQ	Army qualification
ARM	Advanced rifle marksmanship
ATC	Army Training Center
BCT	Basic Combat Training
BRM	Basic Rifle Marksmanship
BUIS	Backup iron sight
CARTC	Combat assault rifle training course
CCO	Close combat optic
CFF	Combat field fire
DA	Department of the Army
DS	Drill sergeant
EX	Expert
FM	Field Manual
IET	Initial Entry Training
IS	Iron sight
KD	Known distance
LOMAH	Location of misses and hits
MM	Marksman
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OSUT	One Station Unit Training
POI	Program of Instruction
SPORTS	Slap, Pull, Observe, Release, Tap, Squeeze (malfunction steps)
SS	Sharpshooter
TPU	T means trained, P means needs practice, U means not trained
UQ	Unqualified
USAIS	United States Army Infantry School